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Heavy Tonnage from a Small Floor

Co-ordinating the Supply of Materials and the Sequence of Operation Essential To the Molding and Pouring of Castings Has Resulted in Greatly Increased Output

CONDITIONS peculiar to the foundry and to a certain extent perhaps, a natural conservation of those engaged in the industry has retarded the adoption of automatic and semiautomatic methods in the various processes incident to the production of castings. The automotive industry, with its demand for hundreds of thousands of duplicate castings has done more than any other single agency to modernize the foundry and place it on a par with the machine shop. One of the principal problems confronting the foundryman was to synchronize the different steps in the production of his castings to take full advantage of his molding machine equipment. Molding machine manufacturers always have been in advance and the problem has been to supply sand and take away the finished molds so that the molding machine would be in continuous

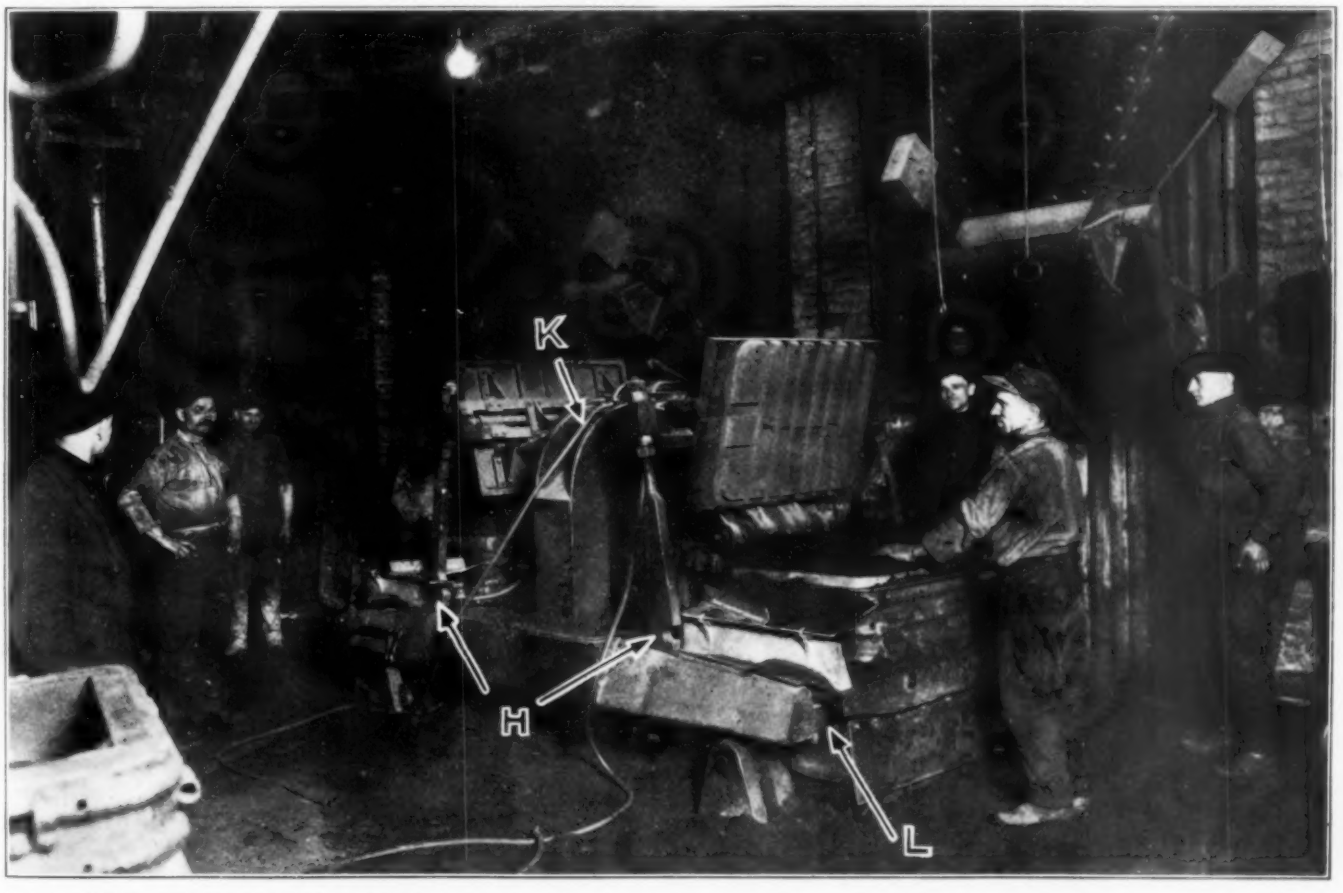


FIG. 1—INDEPENDENT JOLTING AND SQUEEZING MECHANISM IS PROVIDED FOR EACH END OF THE MACHINE, BUT A LIFTING DEVICE IN THE CENTER SERVES TO STRIP BOTH PATTERNS FROM THE COPE AND DRAG SIMULTANEOUSLY

FIG. 2—THE CORES ARE SET AND TESTED BY GAGES WHILE THE MOLDS ARE MOVING ALONG ON THE CONVEYOR

operation. The need for meeting larger and increasingly larger production schedules has introduced another factor in the shape of immense floor space and the necessary buildings to cover that space. The human element, depending on the class of labor available, also must be taken into consideration.

The problem in its various phases for several years has received the earnest consideration of the executive staff connected with the Ferro Machine & Foundry Co., Cleveland. Developments tending toward economy of operation and increased output have been noted in THE FOUNDRY from time to time including Sept. 15, 1919, and Nov. 15, 1920. The former article dealt in considerable detail with the continuous production of tractor transmission housings in which both core and mold were formed in green sand and the latter described a new type of molding machine developd by the Stoney Foundry Engineering & Equipment Co., for the production of Chevrolet cylinders, molds and cores, in green sand. A considerable amount of the equipment which figured in both these descriptions still is in operation, but the molding machine has been changed and adapted to some extent and is now engaged in the production of Hupmobile 4-cylinder castings. A second machine, slightly larger, is employed in making 6-cylinder castings but as the machines are similar in construction, a description of one will convey a clearer idea than if reference was made to both indiscriminately.

No attempt will be made to describe the entire plant of the Ferro Machine & Foundry Co., with a capacity of 150 tons of castings a day. The accompanying illustrations were taken in a building 34 x 125 feet, adjoining the main foundry and devoted exclusively to handling the product of one molding machine. With the exception of the melting equipment, which is located in the main foundry and the sand handling unit which serves three independent molding installations, the unit is self contained and with a crew of 20 men produces 200 cylinder castings in less than 8 hours a day. This includes molding, setting the cores, closing, pouring and shaking out. The casting weighs 195 pounds so that approximately each man is responsible for 2000 pounds of castings a day. With the exception of the men engaged in setting the cores, the help is of the class known as semiskilled and may be recruited at any time without difficulty. It is claimed that the floor space utilized is only 35 per cent of that required when molds are made in the orthodox manner and distributed over the floor before pouring commences. If necessary two, or even three shifts may be employed, thus keeping the equipment in use the greater part, or, all of the 24 hours at a corresponding reduction in the ratio of floor space to the tonnage produced. Lack of a continuous supply of iron is the only factor preventing continuous operation. The character of the help employed also renders a plan of this kind more elastic and, therefore, more feas-

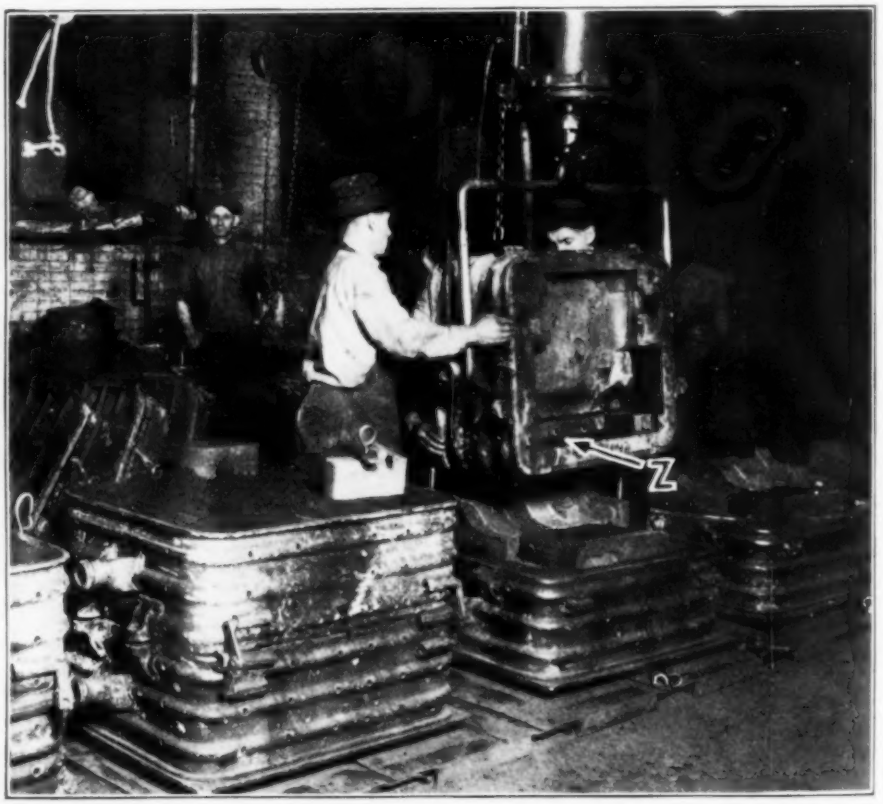


FIG. 3—A HOLLOW-STEEL WEDGE DRIVEN BETWEEN THE FLASK AND THE CENTER OF THE HINGED CLAMP PRODUCES THE NECESSARY TENSION

ible than any other along that line.

The total number of flasks, bottom plates, runner basins, clamps and wedges constitutes another important reason favoring the adoption of continuous molding and pouring. In this particular instance, 30 flasks have been found to be ample to keep the machine going to capacity. Of these from 21 to 24 constantly are on the conveyor, 1 either is going on, or, coming off the molding machine and the remainder are in reserve, cooling.

Seven Round Trips

The castings are shaken out within a few minutes after they are poured and as a result the flasks do not become heated to any extent. This feature also reduces the tempering and revivifying of the sand to a minimum. The men operating the molding machine and setting the cores do not work much over 7 hours a day and the last mold is poured, the casting shaken out and everything placed in readiness for the following day well within the 8 hour limit.

The plate type conveyor, Fig. 9, 94 feet long, 30 inches wide, supplied by the C. O. Bartlett & Snow Co., Cleveland, is raised slightly above the floor level and travels at the rate of 30 inches per minute. The chains travel over two large sprockets at each end. A take-up is provided at one end to adjust the slack of the chain and a 7½-horsepower motor at the opposite end gives the motive power. The speed reduction is obtained through a large gear and worm drive. The frame, sprockets and all operating parts of the conveyor are located in a tunnel under the floor. It will be noted that the speed of the conveyor, 30 inches a minute, synchronizes with the speed of the molding machine, one complete mold every two minutes. The flasks used are each 26 x 35 inches with cope and drag equal depth 11 inches, or, a combined depth of 22 inches. They are placed lengthways on the conveyor and the 5 feet provided by the operating speed of the conveyor for each flask compensates for the clearance space required at each end of the flask by the men engaged in setting the cores. This speed also works out favorably in relation to the time required to assemble and close the molds, the time required to pour them one at a time, the time required for the casting to set so that it may be lifted out without danger of a spill and finally the time required for the shaking out gang of four men to dump the flasks, lift the castings and return the empty flasks to the molding station. In the natural sequence each flask is used seven times a day, or, on an average once an hour.

FIG. 5—VIBRATORS ATTACHED TO THE BEAM LOOSEN THE SAND SO THAT ONE OR TWO BUMPS FROM A BAR CLEANS THE FLASK

FIG. 4—TWO AIR HOISTS AND ONE CHAIN BLOCK, SUSPENDED FROM THREE PARALLEL MONORAILS ARE EMPLOYED IN SHAKING OUT THE CASTINGS

Combined Jolt and Squeeze

The molding machine, designed by J. T. Stoney, foundry manager the Ferro Machine & Foundry Co., in collaboration with K. Purwin, chief engineer the Stoney Foundry Engineering & Equipment Co., is shown in Fig. 1. It is a twin machine on which both cope and drag are rammed at one time. Each side of the ma-

chine is equipped with independent ramming and squeezing apparatus, but a common cylinder in the center serves to strip both flasks from the patterns simultaneously. The jolting cylinder is located inside and cast integrally with the squeezing piston. Thus, while the jolting cylinder can develop sufficient pressure to raise the load, the squeezing piston, presenting such a larger area, in this instance 20 inches diameter, can develop a squeezing pressure at 80 pounds equal to 15 tons. An ingenious type of valve, also developed by Mr. Purwin regulates the intake and exhaust to a nicety. The efficacy of the valve is indicated by the fact that only 12 jolts are required to ram the flask shown, 26 x 35 x 11 inches, to the proper density. The valve is attached to the air line at a point back of the machine and may be adjusted to suit varying loads. It is set by some responsible person before the job is started. The operator handles a control valve conveniently situated at one side of the machine. He has no adjusting to do, simply throws it wide open after the flask is filled with sand. The squeezing head then is thrown into engagement and after the mold is vented and scraped off flat, cope and drag stripped, it is removed and replaced by another flask. Several additional interesting features in connection with the machine and its manner of operation may best be described by following one of the flasks on one of its 1-hour trips.

Sequence of Operation

The flask is picked up by an air hoist suspended from a trolley system attached to the roof beams. One of these hoists serves each end of the machine, one for the copes and one for the drags, but since the operation at each end is identical and simultaneous the method will be described in the singular for clearness. After the flask is placed on the stripping plate, a clamp is placed over the lug at each end and the flask is clamped securely to the plate by two air-operated plungers. The control valve for this device is shown distinctly at *B*, Fig. 7 and the device itself is shown at *A* in the same illustration. An extension frame, 2 inches deep is placed around the top of the flask and then the swinging extension to the sand chute is brought forward until the lower end hangs over the flask.

The gate on the lower end of the sand hopper is mounted on the same shaft as the sand chute and, therefore, when the chute is pulled forward the gate is lifted from the mouth of the hopper and the sand flows into the flask. The chute is counter weighted and when released by the operator, swings back out of the way and at the same time automatically closes the gate on the bottom of the sand hopper. No facing sand is used to cover the pattern. The flask is filled with one kind of sand throughout and then jolted 12 times as already stated.

After the mold has been jar-rammed sufficiently, the squeezing head is lowered until it rests on the sand. The hooks, two of which are indicated at *H*, Fig. 1, slip down until they engage anchor pins attached to the base casting. The squeezing head is adjustable and may be set to accommodate flasks of various heights. The hooks are guided into place and locked by an air operated plunger. Air is admitted to the lower cylinder and the mold is forced up against the squeezing head. Then it is lowered back to place after which a small pneumatic plunger throws each hook out of engagement with the anchor pins. At the same time air is admitted to a small cylinder operating a crank arm having a throw of 90 degrees which pulls the squeezer head up and out of the way. These operations are accomplished by means of one valve.

The mold is scraped off flush and the drag is vented with a vent wire. Air is admitted to a central cylinder actuating a pair of brackets one of

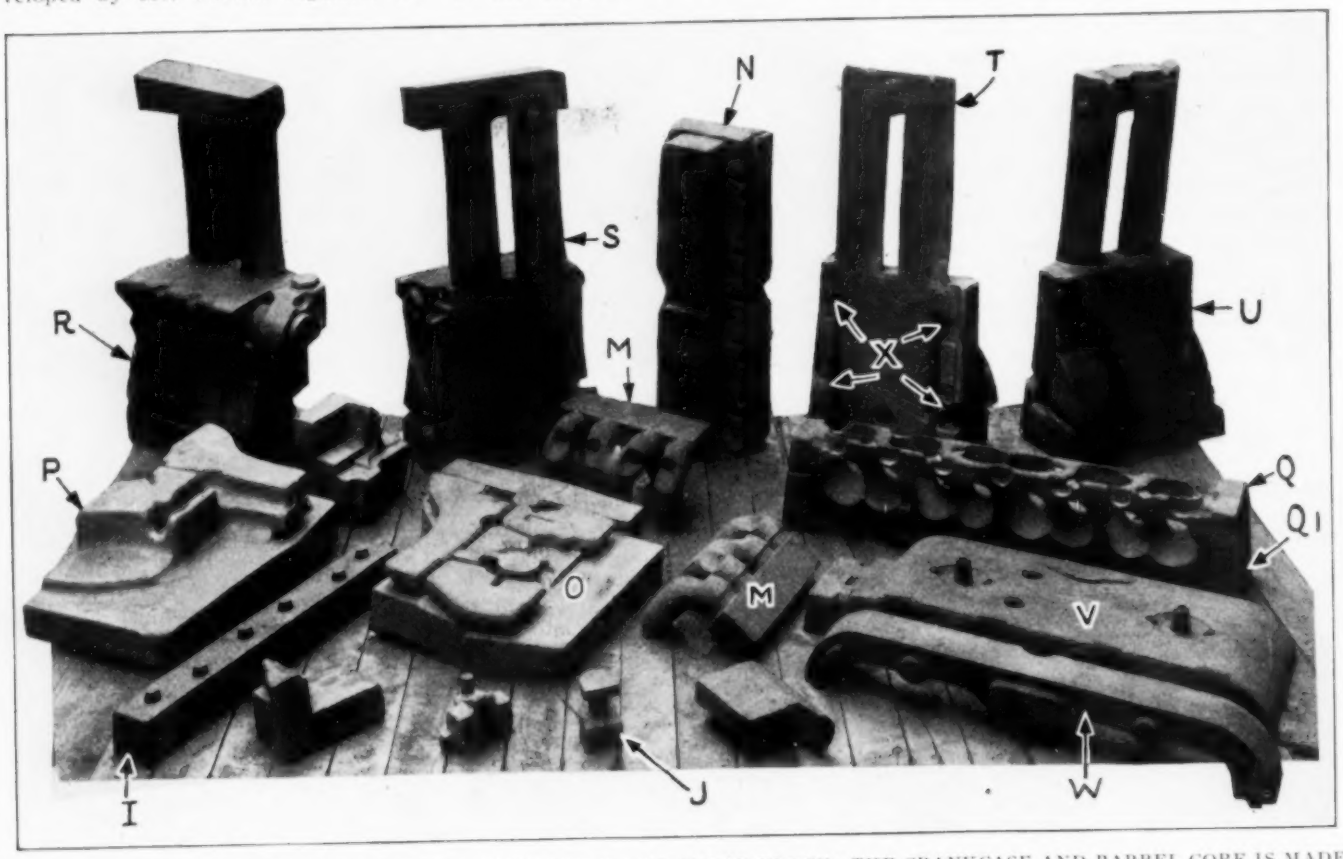


FIG. 6—A COMPLETE SET OF CORES FOR A HUPMOBILE 4-CYLINDER BLOCK—THE CRANKCASE AND BARREL CORE IS MADE IN FOUR SECTIONS TWO UPPER *R* AND *T* AND TWO LOWER *S* AND *U* FOR CONVENIENCE IN HANDLING—THE WATER JACKET CORE *Q*, Q_1, *V* AND *W* ALSO IS MADE IN FOUR SECTIONS FOR THE SAME REASON

which may be seen at *K*, Fig. 1. These brackets in turn are attached to long horizontal arms projecting under the ends of the stripping plates on both ends of the machine. This feature may be observed at the corner *L*, Fig. 1. As the brackets ascend, the horizontal arms carry the stripping plates supporting the flasks, with them. A small air hoist, supporting a beam and a sling removes the drag and sets it on a stand where the finisher sets a strip core in the crankcase core print, the lower section of the water jacket core and a small oil pocket core. These cores are shown as *I*, *Q* and *J* respectively in Fig. 6, which shows an entire set of cores for one of these cylinders. By the time the finisher has set the cores and sprayed the mold with oil and plumbago, the crane has set an empty flask on the molding machine and is available for picking up the drag and setting it on the conveyor. The drag is provided with bars similar to those in the cope and therefore there is no need for attaching a bottom plate to the flask before it is rolled over. A perforated bottom plate is placed on the conveyor, a thin coating of sand is sifted on and then the drag is lowered into place. The cope is lifted off by its own crane at the same time as the drag. It is turned up on edge and set down in that position where a workman pushes a wire through the sand above the various core prints and cuts an additional ¼-inch hole to serve as a riser above the highest peak in the mold.

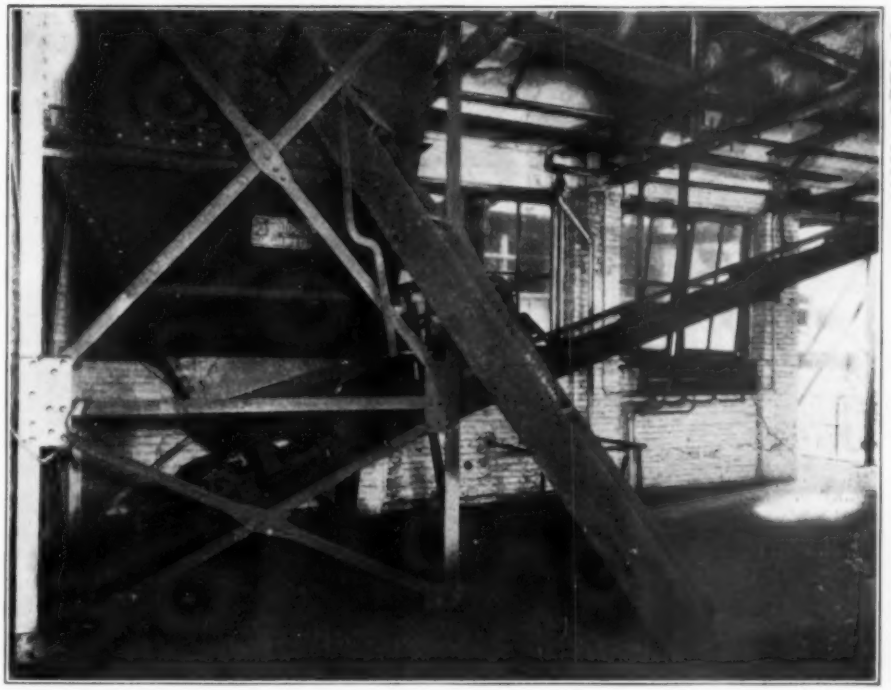


FIG. 8—THE 40-TON HOPPER WHICH FEEDS THE TWO SMALL HOPPERS OVER THE MOLDING MACHINE

Inasmuch as the formation of the molds is a continuous process, it is apparent that several drags will have accumulated on the conveyor before the first one has progressed to a stage where it is ready for the cope. For that reason it is customary to make seven drags before commencing to ram the two halves of the flasks in pairs, a practice of course which necessitates that seven copes are rammed singly after the last drag has been rammed for the day. Two men attend to ramming the copes and two men attend to the drags. A third man handles the crane at each end of the machine, supplying empty flasks and removing them after they have been rammed full of sand and stripped from the patterns.

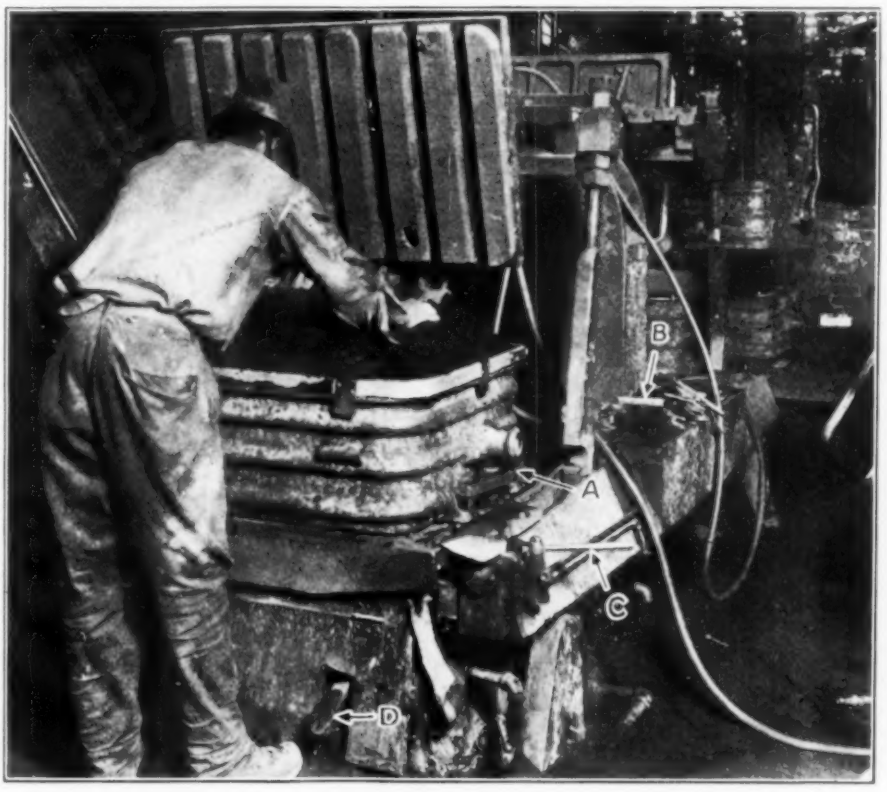


FIG. 7—THIS MACHINE RUNNING ON A 6-CYLINDER JOB IS SIMILAR TO THE ONE SHOWN IN FIG. 1—IT IS INTRODUCED HERE TO SHOW THE CONTROL VALVES *B*, *C* AND *D* AND THE CLAMP *A*—THESE FEATURES IN FIG. 1 ARE NOT IN A FAVORABLE POSITION TO PHOTOGRAPH

After the drag is placed on the conveyor the various cores are set by several men stationed at definite points. Each man sets certain cores as the mold passes his station. For instance the first sets the spring housings and port cores *N* and *M*. Two men set the middle water jacket section *Q* 1, the two bottom halves of the crankcase core with barrels attached *S* and *U*, the gear case core *O*, the fly wheel core *P* and the two top halves of the crankcase core *R* and *T*. It will be noted that the upper part of the water jacket core is made in two parts *V* and *W*. The part *V* forms the cavity in the casting and the part *W* fills the core print. After these last two cores are set, the cope is lowered into place.

Progress in coring the mold is shown in two illustrations, Figs. 2 and 3. In Fig. 2 the view is taken from the end where operations begin and in Fig. 3 the last stages of the operation are shown. The various jigs and gages employed in correctly locating

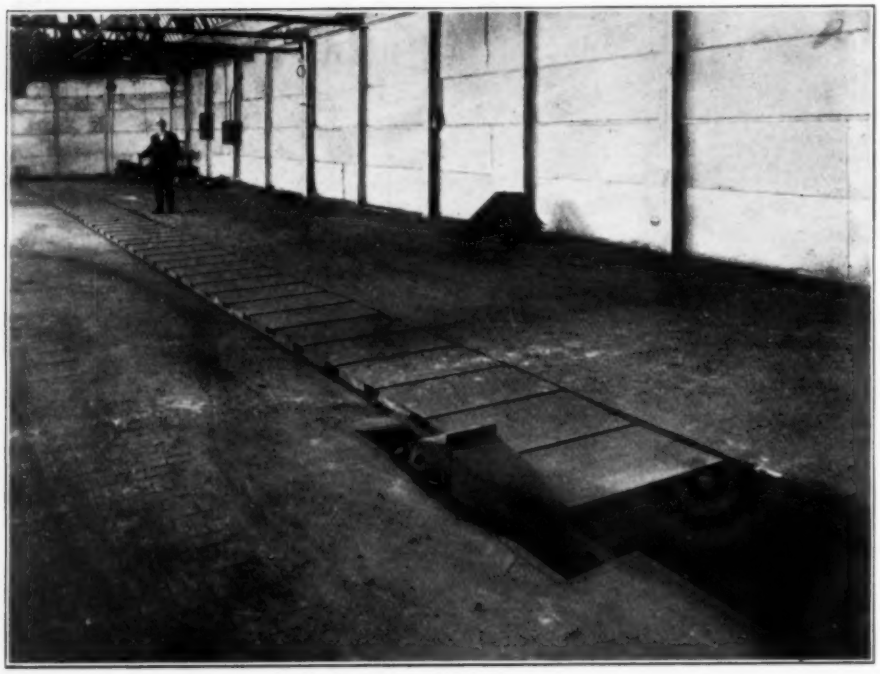


FIG. 9—THE FLOOR AS IT APPEARED AFTER THE CONVEYOR WAS INSTALLED BUT BEFORE ACTIVE OPERATIONS HAD COMMENCED

the cores in the mold may be observed in Fig. 2. The many interesting details shown in Fig. 3, include long guide pins for closing the cope, style of flask construction, clamps and pouring arrangement. The clamp is covered by patent.

Poured Through the Cores

The long guide pins are detachable and are removed after each cope is closed and clamped. The flasks are of rolled steel construction made by the Truscon Steel Co., Youngstown, O., provided with permanent bars, hollow trunnions, guide lugs and handle attachments. Details of this patented clamping device and the manner of its application are shown on the two flasks occupying the foreground in the illustration Fig. 3. The toes of the hinged clamp are inserted in the handle holes, one in the cope and one in the drag at four points on each flask. A hollow steel wedge driven between the flask and the hinged center of the clamp produces the necessary tension. The clamp is simple in construction, practically unbreakable, easily applied and just as easily removed and since not more than six molds ever are ready for pouring at one time, 24 clamps are sufficient. One of the men in the shakeout gang of four, removes the clamps and returns them to the unclamped flasks as fast as the molds reach the shakeout station.

The runner basins are made with a block and oval runner cup as shown in Fig. 3. Neither paper covers, pieces of tin or strainer cores are employed at any point in the runner and yet the foundry loss from all causes has not exceeded 3 per cent. The two upright runners in the cope shown at *Z*, Fig. 3, connect with suitable openings at the back of the upper crankcase cores *R* and *T*, Fig. 6, and these openings in turn distribute the iron through horizontal gates located at the joint of the crankcase cores. Four of the gates are indicated by *X* on core *T*. A similar set of gates are provided on the joint side of core *R*, but this cannot be seen on account of the position of the core in the illustration.

The iron is brought in a 1000-pound ladle from the cupola in the main foundry and poured into a smaller ladle provided with a self skimming spout. One man shoves the 1000-pound ladle back and forth to and from the cupola and two men handle the small ladle from which the castings are poured one at a time. One man does the actual tipping while the other steadies the ladle and operates the chain hoist from which the ladle is suspended from the monorail.

Shaking Out the Castings

The mold passes through three stages, each of which occupies approximately one third the length of the conveyor. The divisions of space are not arbitrary, but on the contrary are sufficiently elastic to prevent any hold-up from minor delays. Thus the mold may be poured immediately after it is clamped, or it may travel two or three flask lengths before it is poured. In the same manner the mold containing the casting may travel almost to the end of the conveyor before it is stripped and shaken out, or it may be picked up at a point 20 feet from the end. In the latter event, approximately 10 minutes elapse between the time the casting is poured and the time it is shaken out.

The shake-out gang is made up of four men. Two men lift and dump the flasks, one lifts the castings and the fourth trucks the flasks and bottom plates back to the molding station. To facilitate the work and prevent confusion incident to piling copes and drags together, three separate monorails, parallel and close together,

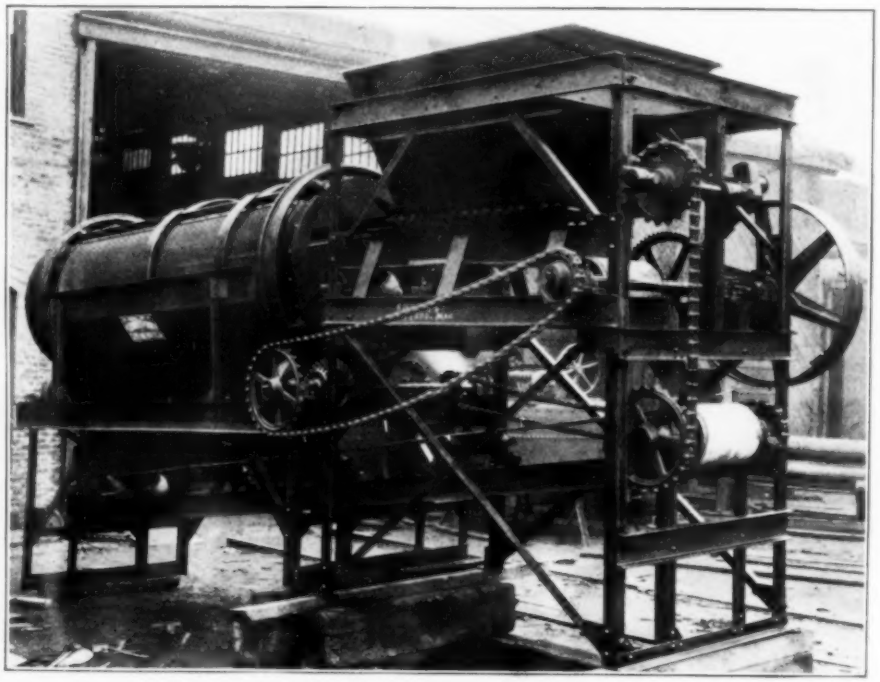


FIG. 10—THE SAND SCREENING UNIT OF THE SAND HANDLING AND CONVEYING EQUIPMENT WAS SET UP AND TESTED AT THE PLANT OF THE BUILDER BEFORE IT WAS SHIPPED AND INSTALLED

are provided. The center rail supports a light chain hoist which lifts the casting as shown in Fig. 4, and conveys it into an adjoining room where it is loaded on a truck in company with several others and taken outside the building until it has stopped smoking.

Vibrator Beam Used

Air hoists suspended from the two remaining monorails are employed for lifting the flasks and conveying them over the shakeout grating, shown in Fig. 5. The chain block hangs plumb over the center of the conveyor and the air hoists are sufficiently near the center to secure an almost vertical lift and yet far enough apart so that the suspended loads from any two hoists may pass each other with a slight lateral pull. The three monorails extend parallel as far as the grating. From this point they separate in suitable curves so that the loads may be dropped where wanted. Thus, the drag hoist lowers the flasks on one side of the floor and the cope hoist lowers the flasks on the opposite side and, as already stated, the chain hoist on the center track conveys the castings into an adjoining department.

The beam on each of the hoists employed for lifting the flasks is equipped with a vibrator at each end, operated by air taken from the hoisting cylinder supply pipe. The action of the vibrator loosens all the sand in the flask and one or two light taps from a bar administered in the manner shown in the illustration, Fig. 5, cleans the flask completely.

The comparative elasticity of the continuous molding and pouring process finds further illustration in the method adopted for shaking out the castings. Instead of shaking out cope and drag alternately and removing the casting between alternate lifts, the method shown in Fig. 4 is practiced. The flask men start lifting copes while the end of the line still is 12 or 15 feet away from the end of the conveyor. They lift five or six copes consecutively, followed by the man lifting the castings, before they lift the drags. No hard and fast rule is laid down covering the sequence of operation in shaking out the molds. The shaking out gang can exercise its own discretion so long as the conveyor is cleared before the plates disappear beneath the floor for the return journey.

Mixing the Sand

The sand from the flasks falls through the grating shown in Fig. 5 onto a wide belt which discharges into a revolving screen. The general features of this screen may be noted in Fig. 10 shown set up for test at the plant of the C. O. Bartlett & Snow Co., Cleveland, which manufactured the sand handling and conveying equipment used. The screen is set up at a slight angle and automatically discharges through the open end, all foreign material too large to go through the meshes of the screen. The sand, falling through the screen, is carried by a belt to the boot of a vertical elevator. From here it is conveyed up to the second story and discharged onto a belt which discharges on top of a squirrel cage disintegrator. On the way to the disintegrator it is passed under a water spray. From the disintegrator it is carried into a central hopper designed to supply three molding units similar in general features to the one dealt with in this description.

In the particular instance under discussion, a belt conveys the sand from the central hopper to the 40-ton hopper located in one corner of the building where the molds are made and at the same end as the grating through which the sand is shaken out of the flasks. This second hopper is shown in Fig. 8, together with the overflow spout leading to the grating, in the event that the amount of sand flowing into the hopper should exceed the amount going out. A conveyor belt carries the sand from the 40-ton hopper to the two hoppers, each of 2½-yards capacity, located over the molding machine and shown in the upper background Fig. 1. That completes the circuit and brings us back to where we commenced.

The discharge under the 40-ton hopper may be regulated to supply the sand at any given quantity in a given time to meet the requirements of large or small flasks. If, for any reason, the molding operations are interrupted, the flow of sand may be shut off by stopping the motor which drives the conveying mechanism under the hopper. Plows, located above each of the small hoppers, and controlled from the floor, serve to divert the sand into either, or both, of the hoppers at one time. The amount of sand may be gaged so nicely to actual consumption that little, if any is carried over the end of the belt. What little falls on the floor is gathered up with the sand that is scraped off the drag each time before it is lifted off the machine. One of the operators gathers the sand and throws two or three shovelfulls into each drag at the same time the sand is flowing down from the chute. This serves the double purpose of keeping the floor clean and at the same time taking care of the sand overflow.

Nonferrous Needs Placed in Convention Program

With a view to increasing the interest and obtaining the active co-operation of foundries making light alloy castings, a tentative plan has been suggested whereby the papers on aluminum-alloy founding and related subjects will be placed in one section for reading at the June convention in Rochester. It is hoped that a representative gathering will be present so that the needs of the industry can be discussed at the time and suggestions offered for future papers on light alloys.

The preparation of the nonferrous sessions of the program is being arranged by L. W. Mueller, H. Mueller Mfg. Co., Decatur, Ill., and R. J. Anderson, metallurgist of the bureau of mines station, Pittsburgh. The following papers have been secured: Technical Control of McCook Field Foundry, by E. H. Dix Jr., McCook Field, Dayton, O.; The Use of Secondary Metals in the Brass Foundry, by C. T. Bragg, Michigan Smelting & Refining Co., Detroit; Porosity of Nonferrous Metals, by R. R. Clarke, Pittsburgh; Two-Part Castings Made in Three-Part Molds, by W. H. Parry, Brooklyn, N. Y.; Aluminum and Aluminum-Alloy Melting Furnaces, by R. J. Anderson, bureau of mines, Pittsburgh; Melting Aluminum for Rolling into Sheet, by J. A. Lange, Western Springs, Ill.; Use of Secondary Aluminum Ingot in Foundry Practice, by W. M. Weil, National Smelting Co., Cleveland; An Investigation of Segregation with a View to Preventing Its Occurrence in High-Lead Bronze Castings, by Prof. R. E. Lee, Allegheny College, Meadville, Pa.

British Firm Books Large Castings Order

One of the largest contracts for castings obtained by a British foundry in several months has recently been signed by a gray iron foundry in the Glasgow district. It calls for an initial lot of 600,000 rail chairs for export to India, at the rate of 50,000 per month. The order, however, is a continuing one and it is expected that the job will last for several years. The rail chairs to be made are of a special type designed for concrete ties. They weigh five pounds each. The contract price is understood to be 7½ pence (16½ cents) per casting. At current exchange the price is, therefore, 3.3 cents per pound. Special molding machine equipment is being installed to handle the job.

THE BLANK FOUNDRY CO

DAILY PRODUCTION REPORT DATE _____

ORDER NO	B P NO	PART NAME	HRS	NO MOLDS	PCS IN MOLD	GROSS PCS	GROSS WT	SCR PCS	SCR WT	NET PCS	NET WT	AV WT	EMPL NO	

Fig 1

DATE	ORD NO	HRS	OWN DEPT				DAY WORK		GROSS PCS	RATE	GROSS EARNG	PCS DISC	DISCOUNT EARNG	NET EARNG	CHECK NO

Fig 2

EMP NAME _____ DEPT _____ AS _____ BADGE NO _____

RATE _____ HR _____

Fig 3

DATE EMPL _____

AGE _____ COLOR _____

MARRIED _____ SINGLE _____

PREV. EMPLOYER _____

AS _____

EMP BY _____ FOREMAN

DATE _____

ORDER NO	NO PIECES		HRS	PIECE RATE	EXTENS.		NO

NAME

Fig 4

THE BLANK FOUNDRY CO

DAILY DISCOUNT SHEET

DATE _____

B P NO	PART NAME	NO PCS	WHY REJECTED	CHARGE DEPT	EMPL NO	PAYROLL CHECK

Fig 5

CASTINGS SHEET

B P NO _____ CUST ORD _____ MFG ORD _____

NAME _____ CUST NAME _____ DATE _____

NO PCS _____ DEL'Y _____ AV WT _____

DATE	EMP NO	HRS	GROSS PCS	GROSS WT	DISCOUNT PCS	DISCOUNT WT	NET PCS	NET WT	NET EARNED	COST PER POUND	O/O DISC	

Fig 6

SHOP ORDER CASTINGS

PART NO _____ CLASSIFICATION _____ ORDER NO _____

NAME _____ WT. _____ NO. PCS. _____ DATE _____

DATE	EMP NO	HRS	GROSS PCS	GROSS WT	DISCOUNT PCS	DISCOUNT WT	NET PCS	NET WT	LABOR	COST PER POUND		

Fig 7

SHOP ORDER WORK SHEET

PART NO _____ NAME _____ S. O. NO. _____

INSTRUCTIONS _____ P. O. NO. _____

CLASSIFICATION _____ DATE _____

LABOR		MATERIALS		LABOR		MATERIALS	
DATE	VALUE	DATE	VALUE	DATE	VALUE	DATE	VALUE

Fig 8

CORE WORK SHEET

PART NO _____ NO PCS _____ PROD ORD NO. _____

NAME _____ CORE WT _____ CASTG WT _____ DATE _____

DATE	EMPL	LABOR	CASTG WT	COST CASTG POUND			DATE	EMPL	LABOR	CASTG WT	COST CASTG POUND		

Fig 9

FIG. 1—FORM USED TO KEEP RECORDS OF DAILY PRODUCTION FIGS. 2 AND 3—BACK AND FRONT, RESPECTIVELY OF DAILY DISTRIBUTION OF LABOR SHEET FIG. 4—EMPLOYES CLOCK AND WORK CARD FIG. 5—SCRAP SHEET FIG. 6—FORM USED TO BEGIN IN FINDING A JOB COST FIG. 7—FORM FOR RECORDING WORK DONE FOR THE PLANT FIG. 8—COVERS INTERNAL REPAIRS AND NEW CONSTRUCTION FIG. 9—CORE WORK SHEET

System Keeps Tab on Foundry Costs

Simplified Method Is Outlined for Finding and Estimating Costs of Castings—Adaptable to Small Shops Where a Complicated System Would Entail Too Much Expense

BY H. C. KELLER

SMALL foundries, as a rule, have poor and in some instances no facilities for determining the comparative costs of their various products. Sound business policy dictates that every manufacturer should know which items of his production are profitable and which are not. A practically one-man system such as is described in this article makes it possible for even the smallest foundries to know the things that are so vital to their success, at a minimum expense. This system has been in use in a Michigan foundry for over a year, and has given remarkably accurate results for both cost finding and estimating new work.

The success of the system rests upon a number of forms on which the data are kept. The daily production report Fig. 1 shows in detail, the activities of the molding department. It serves for cost purposes as well as production comparison. This form provides columns for manufacturing order number; blueprint number; part name; hours worked; number of molds; number of pieces in mold; gross number of pieces; gross weight; pieces scrap; scrap weight; net pieces; net weight; average weight per piece. It is made up daily by the general time clerk.

The use of daily time cards in a foundry where employes work on production runs is by far the most economical method of keeping a record of the worker's time, as it eliminates the departmental time clerk. Instead, the general time clerk is introduced. He should be familiar at all times with all production orders in process. Each employe has an individual card for the day. Fig. 4, which serves as clock card and work card. The clerk records in proper columns the manufacturing order number and the hours for each job on which the man has woked during the day. These cards, covering all departments, are turned in daily to the payroll clerk who makes the extension of labor value in the column provided for the purpose. Time cards are then posted to the time book.

This time book must be carefully kept as it is the ultimate factor in making up the payroll. It is sometimes called the detailed distribution of labor sheet. It is customary to keep the labor of each department separate and to maintain individual sheets for each employe. On each sheet appears the date, order number, hours worked, amount earned, number of pieces produced, and discount or scrap, as indicated by Fig. 2.

All production is inspected daily and copies of the scrap report, Fig. 5, are furnished to the general time clerk and payroll clerk. Through posting these discounts in the time book, deductions are made from the amount earned by the man responsible for the scrap. The amount of scrap reported is posted on the daily production report for use in cost finding and daily comparisons.

On receipt of copies of production orders from the order department, the cost clerk makes preparations to receive data from the various sources regarding the cost of the order. The castings sheet, Fig. 6, may be used as a key to begin with in finding a job cost. In the case of production runs, the sheet is filed according to the name of the product. By this means it quickly can be determined how many orders are on file to cover any one piece. Columns and spaces are provided to show part name, manufacturing order number, customer's name, customer's order number, number of pieces required, and date of order. Provision is made for posting all production and scrap as shown by the daily production sheet, and all direct labor is taken from the time book.

The shop order castings work sheet, Fig. 7, covers the same production data as the castings sheet. It is used for interior work such as casting repair parts for machines and flask equipment.

Classification of work to be done and the order number against which the work will be charged are shown on the shop order work sheet, Fig. 8. This form is for miscellaneous inte-

Table I

Outline of Work Sheets

	Divisor for average cost per pound	Divisor for job cost per pound
1—Molding—Direct labor and helpers	D	F
2—Molding—Foremen's salaries	D	D
Plant overhead	D	D
3—Iron Dept.—Labor	C	C
(Cupola) Foreman's salary	C	C
Plant overhead	C	C
Coke, limestone, fireclay	average monthly from usage sheet	
Iron—pig and scrap	average for three month periods	
4—Cleaning and grinding, direct labor (piecework)	G	F
5—Cleaning and grinding, plant overhead, salaries, inspection, shipping	D	D
6—Cleaning and grinding, general labor	D	D
7—Core room—Direct labor	E	F
8—Core room—(A) General labor, foreman's salary, plant overhead	E	E
Then distribute by percentage on direct labor method as per example following:		
Core room (B) Oil, sand, supplies	E	For job cost distributed by core weight as per sample.
9—Pattern dept.—Direct labor	D	Shop orders cover job cost
Plant overhead	D	D
10—Executive office, etc.—Executive and office salaries, watchman and janitor	D	D
11—General labor—Foundry, yard, nightmen, millwrights and carpenters, not charged to work orders	D	D
12—Castings overhead	D	For job cost distributed on area and production hour basis per sample

Symbols: C = Net pounds production.
D = Net pounds salable production.
E = Net pounds salable cored production.
F = Net pounds production per job.
G = Net pounds cleaned on piece work basis.

Table II

Example of Job Cost

Casting No. 555—Production period—two weeks.
Casting sheet shows—Net production, 935 pieces; unit weight, 3.5 pounds; net weight, 3273 pounds; direct molding labor, $59.67.

Division 1—Divide direct molding labor by net weight of job to get cost per pound—$59.67 ÷ 3273 = 0.0182.

Division 2—Divide foreman's salaries by total net weight of salable production—$253.88 ÷ 308,511 = 0.0008.
Divide allotment of plant overhead by total net weight of salable production—$960.82 ÷ 308,511 = 0.0031.

Division 3—Divide cupola labor by net pounds production—$525.00 ÷ 315,825 = 0.0016.
Divide cupola salaries by same factor—$136.52 ÷ 315,825 = 0.0004.
Divide plant overhead by same factor—$282.48 ÷ 315,825 = 0.0009.
Average usage coke, limestone, fireclay—0.0019 per pound of net production.
Pig iron and scrap average for period—0.0188 per pound.

Division 4—Refer to form T—
Divide direct cleaning and grinding labor per job by net pounds production per job—$7.20 ÷ 3273 = 0.0022.

Division 5—Divide total of cleaning and grinding plant overhead, salaries, inspection and shipping charges by net pounds salable production—$639.38 ÷ 308,511 = 0.0020.

Division 6—Divide total cleaning and grinding general labor by net pounds of salable production—$581.34 ÷ 308,511 = 0.0019.

Division 7—Refer to core works sheet—Divide direct core labor per job by net pounds production per job—$24.16 ÷ 3273 = 0.0073.

Division 8A—Distribute by percentage on direct labor method—general labor, foreman's salary, plant overhead.
Divide direct core labor on job by the total direct core labor—$24.16 ÷ $1134.95 = 2.12 per cent.
Multiply total of items in this division by 2.12 per cent to get overhead proportion for this job—$505.21 × 0.0212 = $10.71.
Divide proportion of overhead by net pounds production on job—$10.71 ÷ 3273 = 0.0033 per pound.

Division 8B—Distribute in proportion to individual core weight—oil, sand and supplies.
Divide total cost of these items by total weight of all cores made, to get cost per core pound—$838.90 ÷ 148,807 = 0.0056.
Multiply unit core weight by number of pieces net production per job—2.75 × 935 = 2571 pounds total core weight per job.
Multiply total core weight per job by cost per core pound—2571 × 0.0056 = $14.40—cost of all cores on job.
Divide core cost by net pounds production on job—$14.40 ÷ 3273 = 0.0041 per pound of production.

Division 9—Divide pattern department plant overhead by net pounds of salable production—$130.10 ÷ 308,511 = 0.0004.

Division 10—Divide these items by net pounds of salable production—$1351.30 ÷ 308,511 = 0.0043.

Division 11—Divide these items by net pounds of salable production—$2714.77 ÷ 308,511 = 0.0088.

Division 12—As has been suggested, an overhead schedule should be prepared. This shows the amount of castings overhead to be distributed over the period to be $1736.08. The area used by this job is 5.03 per cent of the total production floor space.
The daily production sheet shows that there were 64 production hours on this job.
Multiply the amount of castings overhead by the percentage of area—$1736.08 × 0.0503 = $87.32—overhead for area.
Divide the hours in production by the total floor hours for the period—64 ÷ 96 = 0.66—proportion of time this job was in production.
Multiply overhead for area by proportion of time in production—$87.32 × 0.66 = $57.63—castings overhead for this job.
Divide castings overhead by net pounds production on job—$57.63 ÷ 3273 = 0.0176—overhead per pound.

Total the cost per pound of divisions 1 to 12 and multiply by unit weight of castings—0.0976 × 3.5 = 0.3416—first unit cost.

From shop order castings sheet and shop order works sheet compute total labor and material charges on this piece during the period. Divide this total by the number of net pieces produced—$5.28 ÷ 935 = 0.0056—cost per piece.

Returns and outside scrap—
A record is kept of all return scrap and repair charges, if any. This is averaged periodically to find the charge per unit of net production. On this basis we have a charge of 0.0084 per piece.

Miscellaneous materials—
Requisition for all materials such as parting and chaplets used by the molding department in producing this job are obtained from the stores keeper. The total charges for this job are 32 cents. Divide by the net number of pieces produced—$0.32 ÷ 935 = 0.0003 per piece.

Transportation—
This is charged at current rates. The rate per pound multiplied by the unit weight gives the transportation charge per unit—$0.003 × 3.5 = 0.0105 per piece.
Total the cost per piece of the last five items and add to the first unit cost—$0.3416 + 0.0248 = $0.3664—final cost per piece.

rior repairs and for new construction work. It is also used to cover work on mounting and rigging for production, either new or repair. Provision is made for posting the date, employe's number, labor value, miscellaneous supplies and materials, and their value.

The core work sheets, Fig. 9, are used to record all direct core labor consumed in making cores for production jobs. A separate sheet is used for each order. These are headed with order number, part name and part number. Provision is made for posting the date, employe's number, and the value of direct labor.

The cleaning and grinding sheet is similar to the core work sheet, and the same relative data should be recorded on it.

Information is posted on the several forms for finding costs as follows:

Post to the castings sheet, from daily production report, all data shown on that report.

Post to shop order castings sheet, from daily production report all data shown.

Post to the castings sheet, from time book, all direct molding labor and helpers' labor on specific orders.

Post to shop order castings sheet, from time book, all direct molding labor and helpers' labor on specific orders.

Post to the shop order work sheet, from time book, value of all miscellaneous labor charged to shop orders.

Post to the core work sheet, from time book, value of all direct core labor and general core labor on specific orders.

Post to the cleaning and grinding sheet, from time book, value of all direct cleaning and grinding labor on specific orders.

Distribution of Payroll

A copy of the shop payroll is furnished the cost clerk by the payroll clerk. From this the cost clerk takes the totals for each department. From the accounting department or cashier he obtains figures covering salaries of executives, foremen and office employes. He takes off all foundry labor on specific production from the time book and this amount is classified as molders' helpers. All other diverted labor is also taken off and the proper charges and reliefs are made.

Though there are but five distinct departments, it has been found necessary to make twelve divisions of factors which must be taken into consideration. This of course is governed by varying conditions. A separate work sheet is prepared for each division showing the items under that head. These sheets must be prepared before going farther. Refer to the accompanying schedule of work sheets Table I.

Values are posted to the work sheet outlined in Table I, as follows:

From payroll distribution: The totals per department, of direct, indirect or general labor and salaries.

Plant overhead: Allotted by percentage of area per department.

(*Concluded on Page* 315)

Engine Castings Requirements Rigid

Micrographs Show Variation in the Iron in the Same Castings—Heat Tends To Cause Diesel Engine Cylinder Liners and Pistons To Grow—Study of Requirements Urged

BY H. J. YOUNG

UNUSUAL failures or successes arise out of departures from the normal state, and in order to study the properties of any one type of cast iron, we must be able to reproduce it at will, time and time again. So far as the author has obtained samples he has found no foundry turning out standard iron casting for marine work nor for any other work.

Undoubtedly the first step toward the understanding of cast iron is the control of its composition under ordinary foundry conditions. Some firms are establishing the method of superheating the cupola-melted metal in an electric furnace, while others, mainly abroad, use an open-hearth or air furnace. Good as these methods may be they do not in any way alter the fact that if the cupola-melted metal is out of control any subsequent treatment of it is merely patching up a bad job. If the cupola is to be used at all then the production of cupola-melted metal to any required composition is essential. This control of composition is merely a matter of experience and knowledge, and the day will come when we shall be able to specify our cast iron exactly as we we do now with our steel, and that without the help of any other furnace than the cupola.

In connection with the use of an electric or other furnace in conjunction with a cupola there are several important points to keep in mind. Firstly comes the fact that what we know about cupola practice is insufficient to enable us to predict that what we require cannot be obtained from a cupola. It is a wonderful furnace and little reliable work has been done upon it; far too little to justify us in discarding its use or in rushing into anything involving higher costs of production. Secondly, castings have to be produced at prices which will compete with those of the foreigner; electric power is not cheap in this country, and the upkeep of electric furnaces is no small matter. Lastly it is not to be immediately assumed that the more carbon, phosphorus and sulphur we abstract from the iron the better will be the metal for the purposes of making castings. Empirical or rule-of-thumb methods and reasoning have thus far failed to produce reliable cast iron, and there seems to be a tendency, even among chemists, to throw over the metal known as cast iron and to aim at something of lower carbon content than the cupola will produce and which is more like steel. The time does not seem to be ripe for any such thing and scientific effort would better be directed toward producing improved and standard cast iron from the cupola without any other treatment. At great expense it seems quite an easy task to make improved metal, but if applied science is to justify itself in the world of cast iron it must produce the material at prices such as will enable our castings to command the markets here and abroad.

Before an audience of engineers it would be unsuitable to enter into a highly technical description of cast iron, but, at the same time, it is essential that the modern engineer should get a clearer mental picture of the difficulties and possibilities of his most important material than he has possessed up to the present.

The metal flowing from the cupola is saturated with combined carbon; it is like extremely high-carbon steel and therefore, when drastically chilled, the metal is white and uncutable. However, the cooling is slow, then the iron cannot hold all its carbon, and throws some of it out in the form of graphite flakes or plates. This happens immediately the metal begins to go solid and continues as it cools through its critical ranges. The slower the cooling the longer time does the metal have in which to free itself of carbon, and consequently the more numerous will be the flakes of graphite, and, in

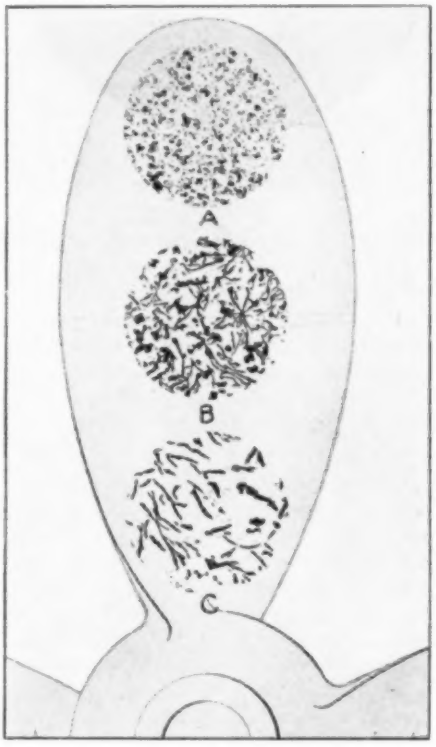


FIG. 1—PROPELLER SHOWING VARIATION OF GRAPHITE ACCORDING TO POSITION—X 12 DIA.

Abstract from a paper presented by H. J. Young at a recent meeting of the British Institute of Marine Engineers held in London. The author is chief chemist, the North Eastern Marine Engine Co., Ltd., Wallsend-on-Tyne.

FIG. 2—WELD IN CAST IRON—X 25 DIA.

FIG. 3—SAME AS FIG. 2, SHOWING GENERAL STRUCTURE—X 25 DIA.

FIG. 4—GRAPHITE IN PIG IRON—X 50 DIA. FIGS. 5 AND 6—DIFFERENT TYPES OF GRAPHITE IN CAST IRON—X 50 DIA. FORMATION OF PHOSPHIDE LAKES IN CAST IRON—X 25 D

some cases, the larger also will be those flakes.

We come now to the logical conclusion that gray cast iron is a high-carbon steel cut up by and surrounding innumerable plates of graphite, namely, a matrix of steel containing many spaces filled with graphite. For this reason cast iron can be machined readily, the unhomogeneous material collapsing under the stresses produced by the edge of the cutting tool; for the same reason also has it little or no elongation, and many other properties peculiar to itself.

A practical object lesson of the truth of these statements is obtained from a large propeller casting, blades and boss complete, and weighing, say, 11 tons or more. Here the great mass of the boss causes extremely slow cooling of the adjacent parts, and also the section of the blades themselves gets less, the further it is from the boss. In practice, the molten metal flowing to the tips of the blades is almost chilled, and, therefore, the tips tend to become hard and brittle, and contain but little free carbon. A short distance from the tip, this cooling is less severe and more carbon is released, with the consequence that the metal is grey but rather hard—the metal being as seen at *A*, Fig. 2.

Graphite Varies With Section

Half-way up the blade, the section is greater and the heat given off by the cooling of the boss delays the cooling, hence the metal will contain larger flakes or graphite, as shown at *B*. At the root of the blade, where it joins the boss, the cooling will be exeremely slow, therefore the iron has time to free itself almost entirely from combined carbon, and when cold is found to be full of large graphite flakes, as shown at *C*.

Thus does a propeller casting demonstrate the fact that the quantity and size of the graphite is greatly ruled by the rate of cooling of the metal. Also, it shows how impossible it is to expect the test bar to represent the casting, and if the test bar be cut out of the casting itself the result will be representative only of that part of the casting from which it was cut.

Another practical example may be obtained from what the foundryman calls a *burn*. When a casting is slightly defective it is sometimes possible to *burn* on a new piece by running molten metal over the defective part until the surface of the original casting begins to get molten and the stream is checked and the metal allowed to solidify. A burn is similar to a weld. Fig. 1 shows the graphite in a section of the metal taken at right angles to the *burn*, where the same effects are observed as in the case of the propeller—the casting itself having large graphite and the *burnt-on* metal, owing to rapid chilling, having small graphite flakes and few of them.

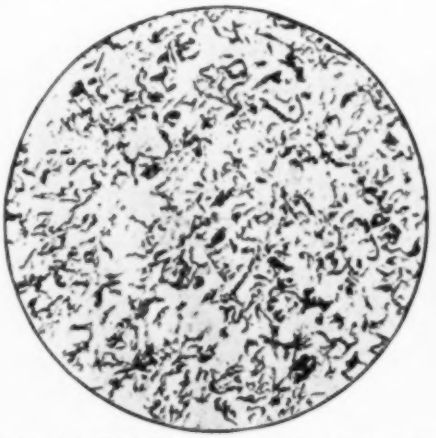


FIG. 7—TEST BAR CAST ON LINER, SHOWING GRAPHITE—X 25 DIA. FIG. 8—TEST BAR CAST ON LINER, SHOWING PEARLITE—X 1100 DIA.

Of course, the metal with the smaller amount of graphite will be much harder and less machinable. An interesting study is presented by the combined carbon and general structure of the *burn* as seen in Fig. 3, and fir-tree growth of long crystals being particularly noticeable and enlightening.

From these illustrations it should be easily understood that the quantity, formation, size and distribution of the free carbon or graphite have enormous effects upon the properties of the metal. The micrographs shown in Figs. 4, 5 and 6 give an idea of some different kinds and formations of graphite.

Laminations Indicate Pearlite

The matrix of iron, in which the graphite occurs, contains the remainder of the carbon combined with it, and, under the microscope, this carbide is seen in thin layers or laminations having a characteristic appearance by reason of which it has been christened *pearlite*. However, should there be more combined carbon than is required to form the greatest possible amount of these pearly layers, then the excess forms more definite and relatively thicker lamellæ, called *cementite*. These make up a kind of network structure throughout the material, dividing it into grains.

A test bar was cut from a liner which including the head weighed about 3¼ tons at a section 1 inch thick. From this head, which was about 4½ inches thick another testbar was cut and compared with the testbar cast on the casting. Both bars were machined to 0.789 inches

diameter. Figs. 7 and 8 respectively show the graphite and the pearlite in the test bar *cast on the casting*, while Figs. 9 and 10 show the same in the test bar *cut out of the casting*. It may be seen that the graphite and pearlite in the former are small in size compared with those of the latter.

This cylinder liner metal is of interest because it has had some little success in actual service. Under superheat conditions, and even under ordinary conditions, the usual liner metal leaves much to be desired, and the metal shown was evolved gradually over a number of years of observation of the behavior of various kinds of cast iron. Heavy and thick as are these castings, the test bars cut out of them give nearly the same tests as the test bars cast on them, namely about 27,000 pounds per square inch tensile strength, and 2300 pounds transverse strength on admiralty square bar.

The metal has a low Brinell number, in the neighborhood of 212 or less, but cannot be cut with a hacksaw. It can be machined commercially in the shops at the rate of 45 feet per minute with a depth of cut of ¼ inch by 1/32 inch feed per revolution. After machining, a good surface is left which develops under service conditions and exhibits the desired wearing properties.

Phosphorus Segregations

Phosphorus in cast iron is the element without which most foundries would close down through inability to run castings with cupola-melted metal. The phosphides solidify later than the mass of the metal and consequently form segregations in between the iron crystals—particularly in large castings where the cooling is slow.

Fig. 11 depicts one of these phosphide segregations as a lake of brittle material separating several of the iron crystals. At a lower magnification in Fig. 12 may be seen how these lakes

FIG. 9—TEST BAR CUT OUT OF LINER, SHOWING GRAPHITE—X 25 DIA. FIG. 10—TEST BAR CUT OUT OF LINER, SHOWING PEARLITE—X 1100 DIA.

occur throughout the mass; while Figs. 13 and 14 different types of net-work structure.

The phosphorus content should be kept as low as is found compatible

FIG. 11—PHOSPHIDE LAKE SEPARATING CRYSTALS—X 250 DIA.

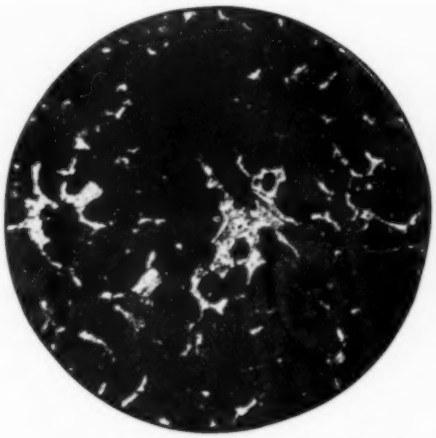
with good foundry results, in heavy work about 0.4 or 0.5 per cent.

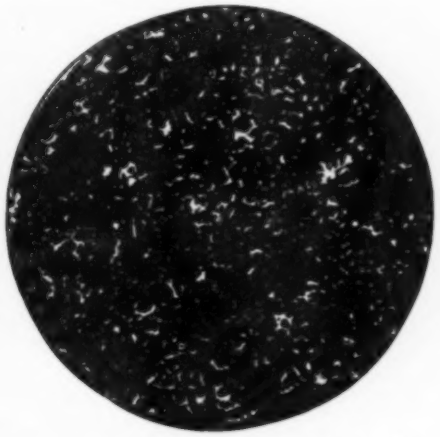
In less important or lighter pieces the phosphorus generaliy should be kept below 1 per cent, while it should rarely go above 1.3 per cent in any casting. The rule-of-thumb foundryman is fond of high phosphorus because the engineer likes a good looking casting, but when the engineer learns to judge other than by the appearance it will be necessary to keep the phosphorus down to some such limits as those suggested here.

Effect of Sulphur

In certain compositions the phosphide appears to be expelled from the grains of the metal, and to assemble around those grains in a net-work similar to, but not the same as, that assumed by the cementite mentioned above. In weak or poor irons this phosphide is retained more or less within the grains of the metal as seen in Fig. 13, but in a strong iron, perhaps of composition similar with the exception of one of two elements, the phosphide is expelled and forms the net work shown in Fig. 14. The future understanding of the true causes and effects of this rejection or retention of the phosphide would seem to be a more important matter than has hitherto been anticipated.

Irons in which the sulphur content is not more than balanced by the manganese content are relatively weak and hard, and possess poor foundry properties as compared with irons sim-





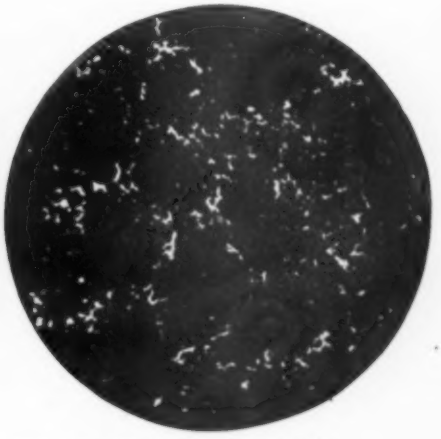


FIG. 13—BAD FORMATION OF PHOSPHIDES IN CAST IRON—X 25 DIA. FIG. 14—THE BETTER FORMATION OF PHOSPHIDES IN CAST IRON—X 25 DIA.

ilar in composition other than that the sulphur is properly balanced. Curiously enough it would appear as if the test of the net work or no net work, Figs. 13 and 14, of the phosphide may be one means of discovering whether the sulphur-manganese balance is swinging in favor of the manganese. It is possible, even probable, that sulphur and manganese together are the most vital combination of elements in cast iron.

Silicon control has assisted iron founders the world over, but sometimes it fails, and the failure is usually attributed by the foundrymen to high sulphur. Overwhelming prejudice has prevented anyone from experimenting practically with high sulphur metal, but hundreds of tests in ordinary practice have proved to the author that good irons can be made with as much or more sulphur than is contained by other poor irons said to be poor by reason of their sulphur, the real difference being that the good iron has enough manganese to completely balance the sulphur whereas the poor iron has not.

Little Evidence Backs Theories

The author is well aware that other theories exist and are warmly upheld by their exponents, but he merely offers these practical results and observations as something better to work on, something impersonal and more scientific, than the many disconcerting theories now existing upon little more evidence than the fact that two irons (of similar composition) are found to give different physical tests and somebody comes up and says "therefore it must be the pig iron, or the oxygen" but offers no convincing proofs, indeed, usually offers no proofs at all.

Silicon control is often too weak and the test bar is liable to have superior properties and composition to the casting it represents. Moreover, it is sometimes impossible to alter the silicon percentage for fear of harming other properties essential to the making of a good casting. With sulphur control, low sulphur for one type of work and higher sulphur for another, these difficulties can be overcome and the condition, amount and disposition of the carbon and the eutectics can be controlled in the casting itself, the *sine qua non* being that no matter what the quantity of sulphur that of the manganese must be more than sufficient to balance it.

The occurrence of the sulphides in cast iron is extremely interesting. Fig. 15 is a sulphur print of these sulphides, magnified about four diameters. Fig. 16 shows the manganese sulphides as tiny globules, but it is to be remembered that the magnification is 100 diameters and that the globules are infinitely small in the iron itself. Fig. 17 illustrates these same globules photographed at 1600 diameters.

FIG. 16—MANGANESE SULPHIDE GLOBULES IN CAST IRON—X 100 DIA.

Turning to internal combustion and to all high temperature engines, the problem of gray-iron castings is to make them stand up to the work without alteration of strength, form or surface; to be able to make them alike time and time again; to make them from the cupola alone if possible; and finally to make them of such weights and at such prices as will enable our engines to compete in all markets.

When cast iron is drastically heated and cooled several times it begins to grow and the graphite enlarges as shown in Figs. 18 and 19. Assuming that the highest temperature attained by any part of an internal combustion engine is in the neighborhood of 550 degrees Cent. 1020 degrees Fahr. we are up against the problem of producing some type of cast iron which will not suffer from insidious deterioration.

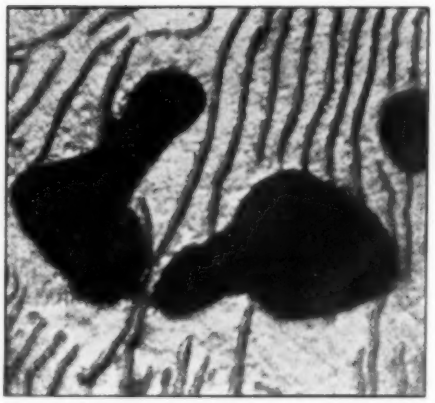


FIG. 17—MANGANESE GLOBULES IN CAST IRON—X 1600 DIA.

In order to be able to raise the working temperatures and pressures of our engines or to lighten their structures it will be necessary to know more about cast iron than we know today.

The foundryman, as a whole, already has accepted the chemist, and the fact is greatly to his credit. However, the engineer must do more than accept the chemist, for he will, in the future, need to accept a certain amount of chemistry. Our big educational institutions, many of them training young engineers, teach little or nothing about cast iron and the metals of commercial engineering, and the result is, that these young men go into the works or into the drawing offices of the works without any mental picture or any conception whatsoever of the behavior and constitution of metals.

The whole system needs overhauling. To accomplish this the Cast Iron Research association should be given a fair sporting chance of proving its worth, and it would appear to be obvious that everybody making, buying, selling or using castings has a stake in this association, and should look after it on the chance of getting value out of it—as a matter of fact there is no chance but a certainty providing the association receives proper support.

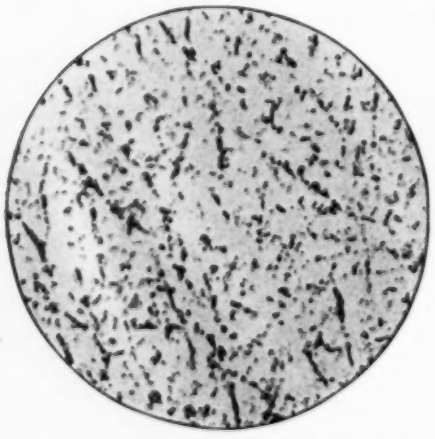


FIG. 15—SULPHUR PRINT OF CAST IRON—X 4 DIA.

FIG. 18—GRAPHITE IN CAST IRON BEFORE GROWTH—X 100 DIA. FIG. 19—GRAPHITE IN SAME SAMPLE AFTER GROWTH—X 100 DIA.

System Keeps Tab on Foundry Costs

(*Concluded from Page* 310)

Castings overhead: Taken as a whole for this purpose.

The items entering into these overheads are determined by the policy of the management. A schedule should be arranged to handle their distribution equitably and in proper order.

From iron schedule: Average price of iron, coke, limestone, and fireclay.

From stores books: Value of core sand and core oil used.

From stores requisitions: Value of miscellaneous core room supplies.

To arrive at an average cost per pound of castings per department, it is necessary to divide the amounts representative of the items, by the devisor for average cost per pound as indicated in the outline of work sheets in Table I. These results are at best an average, as some of the factors will vary in a job cost. However, we have arrived at a point where the work sheets are now of value in finding a job cost.

French Roads Reinforced with Iron

BY FRANCIS MILTOUN

AUTOMOBILE and other vehicular traffic on the roads of France has necessitated the adoption of reinforcement whereby the period of usefulness may be lengthened. During the war the situation was especially serious. Under this impetus the Pont-a-Mousson foundries, after some years of study and experiment, have developed a device for the laying of what may be called a new armored cement pavement or roadway.. At Lyons, Toul, St. Germain and recently in Paris, France, this new form of roadway has been laid and is being used. The assumption is that cement held in place by shallow cast iron cups of a special shape and composition are to secure the cement under all conditions of climate and temperature. The coefficient of expansion is taken as 0.0000143, but no allowance is considered necessary in temperate climates.

Over the entire area of the road a series of skeleton cast iron cups are placed, as shown in Fig. 1. The cups do not touch. With their projecting fins these cups weigh less than a kilogram each and are of a height of about 4 inches. These are embedded in a layer of cement, ultimately filled and slightly covered with another layer and are so laid and constructed as to wear down conjointly with the cement grouting on the surface.

Five of these in each direction, 25 in all, cover a square meter. The wearing resistance of a roadway so laid is dependent upon the wearing down of the cups. Repairs can be made where needed, in spots. Fig. 2 at *A* shows the position of the grids in relation to other road materials.

The distinctive character of the road in Paris is that strips about 5 feet wide are being laid as in the general surface arrangement, but these strips are filled with a red cement, thus making "safety zones."

Something more than experimental applications already have been carried out, as a road at Foug in Lorraine was built 10 years ago. Another stretch at Lyons was used during the war.

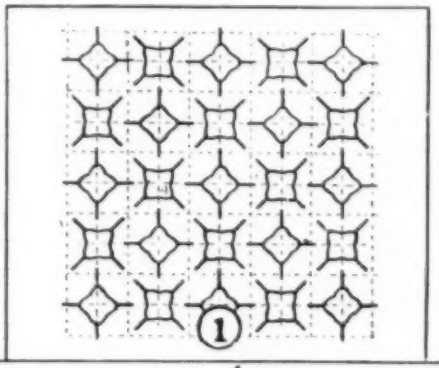


Fig. 1 — Method of laying the cups. The long axis of the road bisects the top and bottom of the illustration. Fig. 2— Cross - sectional view of the roadbed showing relation of the materials used with the cups

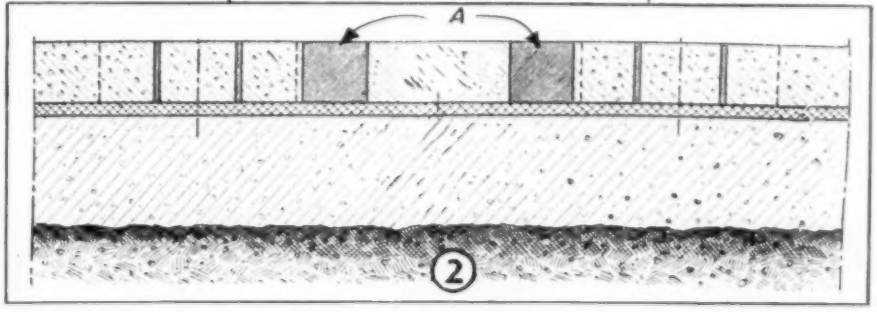
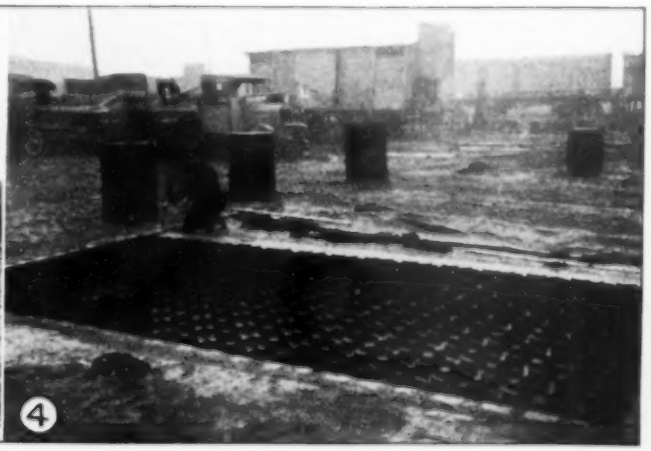


Fig. 3 — Experimenting with the road-building system at Pont-a-Mousson. Fig. 4— Photograph taken during the construction of a roadway for heavy traffic, near Lyons, France. This road withstood wartime traffic



Questions Pig Iron Casting Methods

Advantages and Disadvantages for Foundry Use of Sand-Cast Pig Iron Are Compared with Those of Pig Iron Made by the Machine Casting Process

BY ROBERT E. NEWCOMB

DIVERGENT views among foundrymen as to the relative merits of sand-cast and machine-cast pig iron are indicated by replies of twelve firms casting and machining either steam or hydraulic castings, whose opinion on this subject was asked. Six reported a slight preference for machine-cast pig iron, but stated that they had noticed no particular advantage in its use, although they thought it might melt a trifle easier than sand-cast pig iron. Six expressed a preference for sand-cast pig iron, and four of these indicated a decided preference for sand-cast metal.

At one time I was persuaded that machine-cast pig iron was better than sand-cast pig iron for gray iron foundry use, and carried this opinion into practice. When using machine-cast pig iron of a similar analysis to the sand-cast pig iron I had been using, without change in the mixture, the foundry complained frequently of dull iron and a tendency of the metal to high shrinkage. The machine shop also noticed abnormal shrinkage in the castings. The percentage of scrap in the mixture was reduced with some improved results. Home scrap was then eliminated with a further improvement, and finally sand-cast pig iron was substituted for the machine-cast metal, and the tendency to shrink and the temperature of the melted iron became normal.

The different methods of casting pig iron may be defined as follows:

Sand-cast pig iron is poured into open molds formed in beds of sand. These beds are wet down as soon as they are cooled below the point where the metal would be affected by the water.

Chill-cast pig iron is poured into an open cast-iron mold about eight inches thick, and watered down almost immediately after casting. The method was introduced to secure pig iron free from sand for use in the manufacture of basic open-hearth steel and did not come into general use until the early nineties.

Machine-cast pig iron is cast into metal molds carried on endless chains, and is chilled by passing under a shower of water, then discharged onto a slat conveyer running under water until the iron is cooled when it is discharged into cars. This method was forced by the development of large furnace output for the steel industry, and for economy and to lessen hardships to manual labor. Statements in this article which refer to machine-cast pig iron may also be applied to iron which is chill cast.

It is axiomatic that the cupola should be carefully charged, and the pig iron evenly distributed. In practice few foundries pay sufficient attention to this important phase of cupola management. Careful hand charging is probably preferable to careful machine charging, considered from the metallurgical point of view. The machine-cast brands of pig iron should preferably be charged near the center of the cupola, and away from the lining, to avoid as much as possible the greater tendency to oxidization near the side of the cupola.

Machine-cast pigs of the same brand, being nearly all of one size and shape and relatively smooth, sometimes all shift to one side of the cupola causing a tendency to uneven melting. This skidding off to one side may not occur until the charge has descended in the cupola, due to the process of melting.

Sand-cast pig iron, because of its irregular size and shape, when properly placed in the cupola, either by hand or by mechanical charging, holds its relative position better than machine-cast pigs. For this reason sand-cast pig in the cupola produces better and more even melting.

Few foundries have noted any appreciable difference in the quantity of coke required because of the use of machine or sand-cast pig iron, although it requires more heat, hence coke, to melt sand-cast than machine or chill-cast iron. However, to prevent oxidization the machine-cast pig should be melted higher in the cupola, and this requires a larger bed charge of coke, which tends to cancel any advantage such metal may have because of its lower melting point. The lower melting point of the machine-cast pig is due to the iron being chilled and containing a higher percentage of combined carbon than a sand-cast pig of the same composition. The extreme difference in melting points is about 300 degrees Fahr. Sand-cast pig iron, because of its greater graphitic carbon contents, absorbs considerable more heat up to and including the melting than does machine-cast pig iron. Furthermore, both irons absorb superheat in the cupola, sometimes as much as 200 to 300 degrees Fahr. The sand-cast metal absorbing a greater superheat than that which is machine cast runs to the ladle much hotter.

The sand on the outside of the sand-cast pig iron forms a protective coating and reduces the opportunity of burning or oxidation in the process of melting. Machine-cast pig iron with instantly chilled surface, although clean externally, has entrained impurities more damaging than the protective coating of sand on the sand-cast pig iron. The entrained slag of machine-cast pig iron is more likely to be carried down into the cupola hearth and should here be fluxed off; whereas, a large part of the sand coating of sand-cast pig iron is blown up the stack before the iron arrives in the cupola hearth.

A visible inspection of the fracture of a large number of machine-cast and sand-cast pigs revealed a larger percentage of entrained slag and gas holes in the machine-cast pig. Therefore, the contention that it gives a cleaner melt is open to grave doubt, and the included gases introduced into the cupola an additional menacing influence. The question of slag or sand is of minor importance, but the gases in the machine-cast pig are of primary importance. Let it be thoroughly understood that these entrained gases are seldom brought to the attention of the foundrymen by the chemist's report.

Furthermore, machine cast pig irons being more subject to oxidization in the cupola than that which is sand-cast iron, and because this oxidation of the iron reduces its fluidity, there is a greater tendency for machine-cast pig iron to carry the slag to the bottom of the cupola, and to prevent its release to fluxes. This slag is carried along with the thick sluggish oxidized iron into the ladle and the casting, causing untold trouble. Sand-cast pig iron, being less subject to cupola oxidation than that which is machine-cast, is more easily freed of slag.

It is doubtful if any reliable tests

have been made under practical conditions, which show the comparative loss of metal during its descent in the cupola, owing to the extreme difficulty of obtaining such figures. On page 411 of "Principles of Iron Founding", Moldenke reports tests made showing a melting loss of 0.3 per cent for a 2.00-per cent silicon machine-cast pig iron, as compared to 1.00 per cent for sand-cast iron, attributing the greater loss to the sandcoating on the pig. These figures, favorable to machine-cast pig iron, are more than offset by iron wasted as skulls in the ladles, and lost in pig beds. The melted machine-cast pig iron freezes more quickly than sand-cast pig iron, which is necessarily melted at a higher temperature and hence runs into the ladles hotter.

The degree of fluidity of the molten metal is affected by the quantity of heat above the freezing or solidifying point which is in turn affected by the chemical composition, particularly by carbon, silicon, phosphorus and oxygen. In a comparison of the fluidity of machine-cast with sand-cast metal, it is important to bear in mind that the former is more easily oxidized in melting in the cupola. Dissolved oxide of iron in molten metal raises the freezing point and reduces the fluidity which is so noticeable when using machine-cast pig iron.

Fluidity has a most important relation to shrinkage. The term shrinkage is here used to designate the decrease in volume while the molten metal is passing to a solid mass. An oxidized molten metal having reduced fluidity, freezes quickly, especially at the gates and risers, hence cuts off feeding, causing large voids or shrinks in castings. Machine-cast pig irons have this undesirable characteristic of high shrinkage to a large degree.

Porosity is the term used to designate the invisible voids which permit fluids to seep through the casting. The risers and heads on a casting poured with a sluggish oxidized iron do not exert the full pressure upon the casting, hence the molten iron below releases some of the dissolved gases, as infinitesimal bubbles which form minute porous spots. Hence machine-cast pig irons should not be used for steam, hydraulic, air or ammonia cylinder castings.

All foundrymen are familiar with the loss of iron due to sluggish, dull oxidized iron setting quickly and causing bunging of ladles and increase of overiron. This is frequently directly due to improper melting of machine-cast pig, the cupola operations for which must be more carefully controlled than for sand-cast pig iron.

It appears that the customary practice of judging cast iron by the ultimate analysis is hardly satisfactory. The approximate analysis of cast iron, showing the states in which the different elements exist in the iron, would be more suggestive as to character of the casting. As a rule, chemical analysis disregards many of the minor constituents of the casting but these minor constituents may be of greater importance than is customarily credited to them.

Chemistry is of great value to the foundrymen for the purpose of making up his mixtures, and it appears to be the most reliable means for predicting the future physical characteristics of the castings. However, the chemical analysis of the casting is of little value and does not reliably disclose the physical structure of the casting, which is of paramount interest to the foundrymen and is only disclosed by microsopic inspection.

The customary discussions on the relative merits of machine-cast and sand-cast pig iron are frequently based upon the chemistry of the irons and hence are likely to be misleading. Chemistry, while furnishing valuable information, is not sufficient and must be supplemented by physical and microscopic inspection as well as careful observation of practical foundry results. My observations have been such that I prefer to use sand-cast pig iron.

Spectrum Analysis Aids Metallurgists

Importance and value of spectrum analysis in the field of metallurgy is shown in a paper prepared for the February meeting of the American Institute of Mining and Metallurgical Engineers, held in New York. The authors, W. H. Bassett, technical superintendent and metallurgist, and C. H. Davis, assistant metallurgist, both of the American Brass Co., Waterbury, Conn., have used the spectrum analysis both for analytical and metallurgical work for the past eight years.

They say that to the analyst the complete qualitative analysis of an unknown alloy, revealed by a spectrogram, is a sure basis for the planning of the most direct and rapid method of attack. As the determination of each element proceers, the purity of precipitates may be checked as often as desired. The spectrograph proves invaluable in the recognition of impurities, the separation of which would entail a lengthy and difficult procedure, or when the weight of an unknown is less than is necessary to complete the desired determinations. A few hundredths of a gram will usually suffice for spectrographic analysis. In the separation of the rarer elements, the spectrograph will show, with precision, the point where each step has been successful. In zinc of certain classes, gallium, and germanium have been isolated in this way; the presence of antimony in lake coppers has been proved; and bismuth has been detected in zinc and in alloys where the presence of a few thousandths of a per cent would be harmful. An antimony precipitate in a delicate determination may contain a considerable proportion of tin or arsenic, both of which will be revealed. The spectrograph is consequently important to the metallurgist as well as to the analyst.

Impurities in raw material are often a source of annoyance, especially when their detection involves delay and costly analytical work. Whether low conductivity in copper is due to arsenic, nickel, or something else may be quickly determined. Residual traces of boron, magnesium, manganese, silicon, vanadium, and other deoxidizing agents are easily identified where wet analysis may fail to reveal their presence, even after days of effort. Complex alloys of any kind are dissociated by the spectrograph into a spectrum, the reading of which gives the elements present, together with an idea of the relative amounts of each. The secrets of the inventors of alloys and hardened metals are no great problems when, for their solution, one can depend on the application of the microscope and spectrograph.

A. F. A. Applies Portion of Fund to Sand Study

The research fund of the American Foundrymen's association had its origin in a contribution of $337.11, received from the general committee in charge of local arrangements at the annual convention of the association in Cleveland in 1916, this amount being the balance left over after all expenses had been paid.

The next contribution was received at the Columbus convention in 1920, when Thomas W. and John C. Pangborn made a contribution of $2500 which by action of the board of directors was placed to the credit of the research fund. On Feb. 23, 1921, a further contribution of $1000 was received from Herbert S. Simpson, of the National Engineering Co., making the total contributions $3,837.11, which, together with interest, now totals over $4000.

From this fund is being paid the association's share of the expenses of the joint investigation of molding sand being carried on by the American Foundrymen's association and the National Research council.

Molding a 50-Ton Turbine Runner

The Set of Cores Forming the Mold Was Assembled on an Iron Plate Divided in Two for Convenience in Setting the Last of the Vane Cores

DIFFERENT methods are employed for making the turbine or runner for water power installation, depending to a certain extent on the size and also whether it is to operate in a vertical or horizontal position. Under certain circumstances the top plate, bottom ring and hub are made in cast iron and the buckets or vanes are made of steel plates cut to the correct size and shaped on a block provided for that purpose. These vanes are rammed in a sand mold with one edge and one end projecting into the mold cavity so that the molten iron filling the mold will anchor them firmly in their respective positions. The different steps in the process were described in considerable detail in an article by H. E. Diller which appeared in the Dec. 1, 1921 issue of THE FOUNDRY. In other instances the entire runner, vanes and all, is made in cast iron in one piece. The peculiar shape and twist of the buckets presents an interesting problem to the foundryman. It is apparent that neither of the standard methods for making wheels, a sweep, or a pattern, can be employed for making a casting of this description. It also is apparent that if the mold is made in sections and afterward assembled some special provision or method must be devised for setting the last section. Many ingenious devices have been tried in the comparatively few foundries that handle this class of castings, but in recent years the practice practically has become standardized. The greater part of the mold is assembled on two half plates which then are brought together to form a complete circle.

Dry Sand Cores Employed

In some instances, the outside wall of the mold as high as the water inlet chambers, and in some instances as high as the top of the casting, is swept up in dry sand or loam with a vertical parting on both sides to correspond with the parting in the bottom plate. The buckets or vanes are made in individual cores, one core for each vane. The cope is formed either by ramming a flask over a suitable pattern mounted on a board, or by sweeping it in loam on a plate provided in the center with long dabbers.

In other instances, the outer wall as well as the spaces between the vanes are formed in dry sand cores. Local conditions and personal preference on the part of the superintendent constitute the deciding factors as to which method finally is adopted. A large wheel recently made at the foundry of the William Cramp & Sons Ship & Engine Building Co., Philadelphia, furnishes an interesting example of the latter method. With the exception of the cope which was swept in loam on a plate, the entire mold was formed in sectional cores. Interesting features connected with the pouring of this 10-foot wheel, including the erection of a cupola lined to 84 inches to melt the charge of approximately 116,000 pounds of iron required, were described in the January 1, 1922 issue of THE FOUNDRY.

In laying out the wheel preparatory to making the coreboxes and other rigging, advantage was taken of the fact that the lower edges of the buckets lay along radial lines. The wheel contained 16 buckets, therefore it was

FIG. 1—THE CORES WERE MADE AND DRIED IN AN UPRIGHT POSITION, WHILE GREEN THE OVERHANG WAS SUPPORTED ON A CAST IRON STAND FIG. 2—THE COREBOX FOR THE VANES WAS MADE IN SEVERAL SECTIONS WHICH WERE ASSEMBLED AS THE RAMMING OF THE CORE PROGRESSED

FIG. 3—THE MOLD AS IT APPEARED AFTER NINE OF THE 16 VANE CORES HAD BEEN ADJUSTED IN POSITION—A CIRCLE SCRIBED ON THE PLATE SERVED AS A GUIDE FOR THE RIMS AND THE TEMPLET SHOWN AT *D* SERVED TO LOCATE THE RADIAL SIDE LINES

necessary to divide a circle into 16 equal parts and prepare a corebox with a print on the bottom that would fit exactly between two of the radial lines. The diameter of the outside circle was made to conform to the outside diameter of the ring which surrounded the vanes. The inside diameter of the corebox, which was made as a chord instead of an arc of a circle, was arbitrarily set at a point that would provide a generous margin for a core print and incidentally serve to form the outside wall of the hub. This latter feature is illustrated in Fig. 6, which shows the completed mold before the cover plate was lowered into place. At this point it is fitting to explain that the bottom of the hub was formed by lowering a close fitting cylindrical core in the center between the inner ends of the assembled vane cores. This core was provided on the upper end with a core print

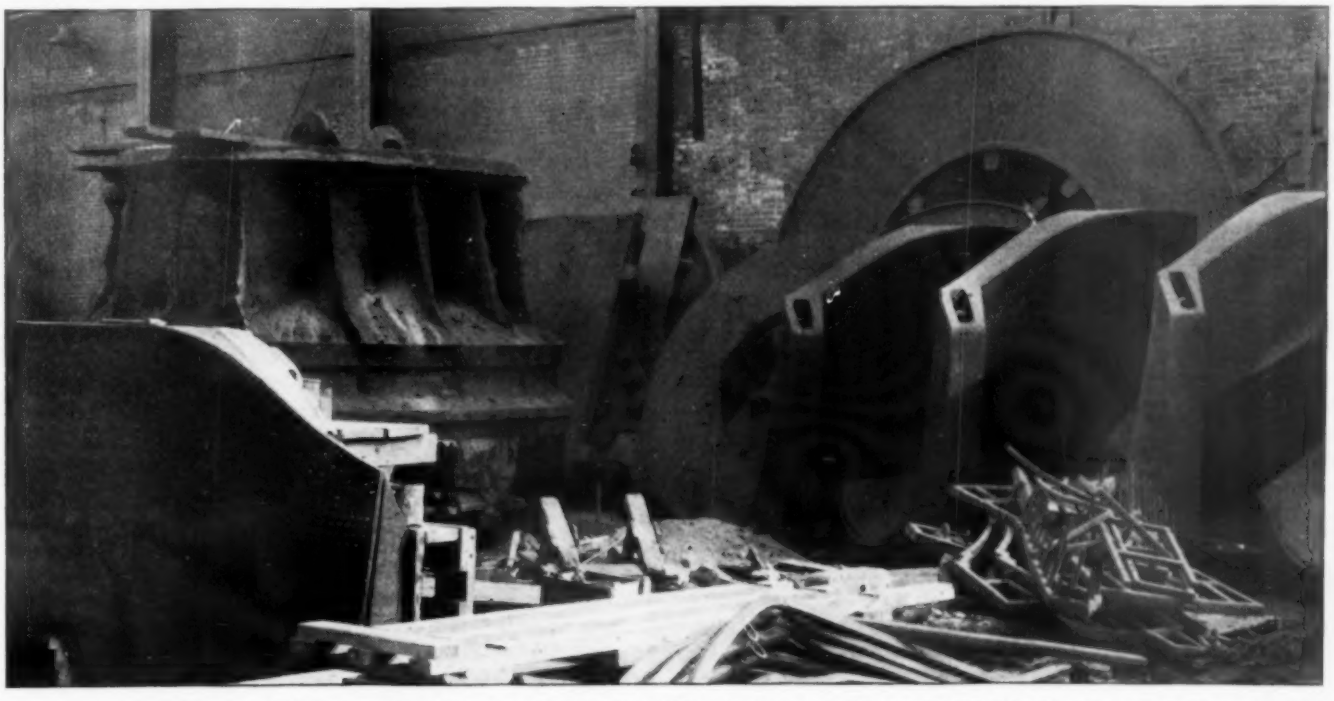


FIG. 4—THE FINISHED CASTING IS SHOWN TO THE LEFT AND PART OF A SET OF VANE CORES FOR A SECOND WHEEL IS SHOWN AT THE RIGHT—THE UPPER PART OF A CORE ST ILL IN THE BOX IS SHOWN IN THE LEFT FOREGROUND AND A NUMBER OF THE ARBORS AND RODS USED IN THE VANE CORES ARE SHOWN IN THE RIGHT FOREGROUND

for the center or shaft core and was of such a length that when the lower end came to rest on the bottom plate, the upper end was in the correct relative position to form the bottom face of the wheel hub.

The principal part of the box used for making the sections between each pair of vanes is shown in Fig. 2. The print conforming to the radial lines already referred to may be noted on the bottom. The box is made in several sections for convenience in ramming the sand and also so that it may be removed from the core before the latter is placed in the oven. The greatest care was necessary in the preparation of the corebox, because in a casting of this kind no variation is permissible in the spacing of the vanes. Absolute accuracy is essential so that the wheel will balance when mounted on its shaft in running position. Millville gravel, a sand indigenous to the Philadelphia district, bonded with a pitch core compound, was employed for making the cores. It is stated that this mixture neither expands nor contracts during the drying process and the cores come out of the oven substantially the same as when they go in.

The corebox 10 feet high, for the convenience of the workmen was set up in a pit while they were ramming the cores. The same pit afterward was employed for assembling the mold and the flat, iron plate provided for assembling the various cores also served as a firm, level foundation for the corebox during the ramming process. The corebox first was set up as shown in Fig. 2. The loose piece (not shown) designed to form the front face then was attached and sand rammed up to the first step. The second loose piece to form the *V*-shaped curve, the step to determine the thickness of metal in the rim and the upper curved face then was attached and bedded into place. Finally the part of the corebox designed to form that part of the core above the shoulder marked *A*, Fig. 2, was secured in place and the core was rammed to the top. The sand was reinforced with five arbors laid horizontally and with six heavy vertical rods the shape of the box. Some of the arbors and rods used are shown in Fig. 4. In addition to the arbors and rods, the cores were rodded and gaggered closely all over. Coke to form a vent was rammed in the center of each core. The vent from each core was taken off at a similar point indicated at *B*, Fig. 5. Hooks anchored to the arbors in a suitable manner were provided for lifting the cores.

After the core was rammed to the top, the loose parts of the box were removed and then the green core was lifted out and placed on one of the core cars. A specially designed stand, accurately machined to the correct height, was placed under the shoulder of the core to support the overhang. The core shown at *C*, Fig. 5, designed to form the outer and lower face of the wheel rim and also to serve as a support for the shoulder on the vane core, presented no unusual features. It was made from the same core sand mixture as was employed for the vane cores and was provided with four lifting hooks attached to a suitable arbor in the bottom of the core. Sixteen of these cores formed a set, one for each of the vanes.

To insure that the cores should line

FIG. 5—THE MOLD AS IT APPEARED WITH THE TWO HALVES JACKED APART—THE OVERHANGING CORES AT EACH SIDE WERE SUPPORTED FROM ABOVE UNTIL THE PLATES WERE BROUGHT TOGETHER AGAIN

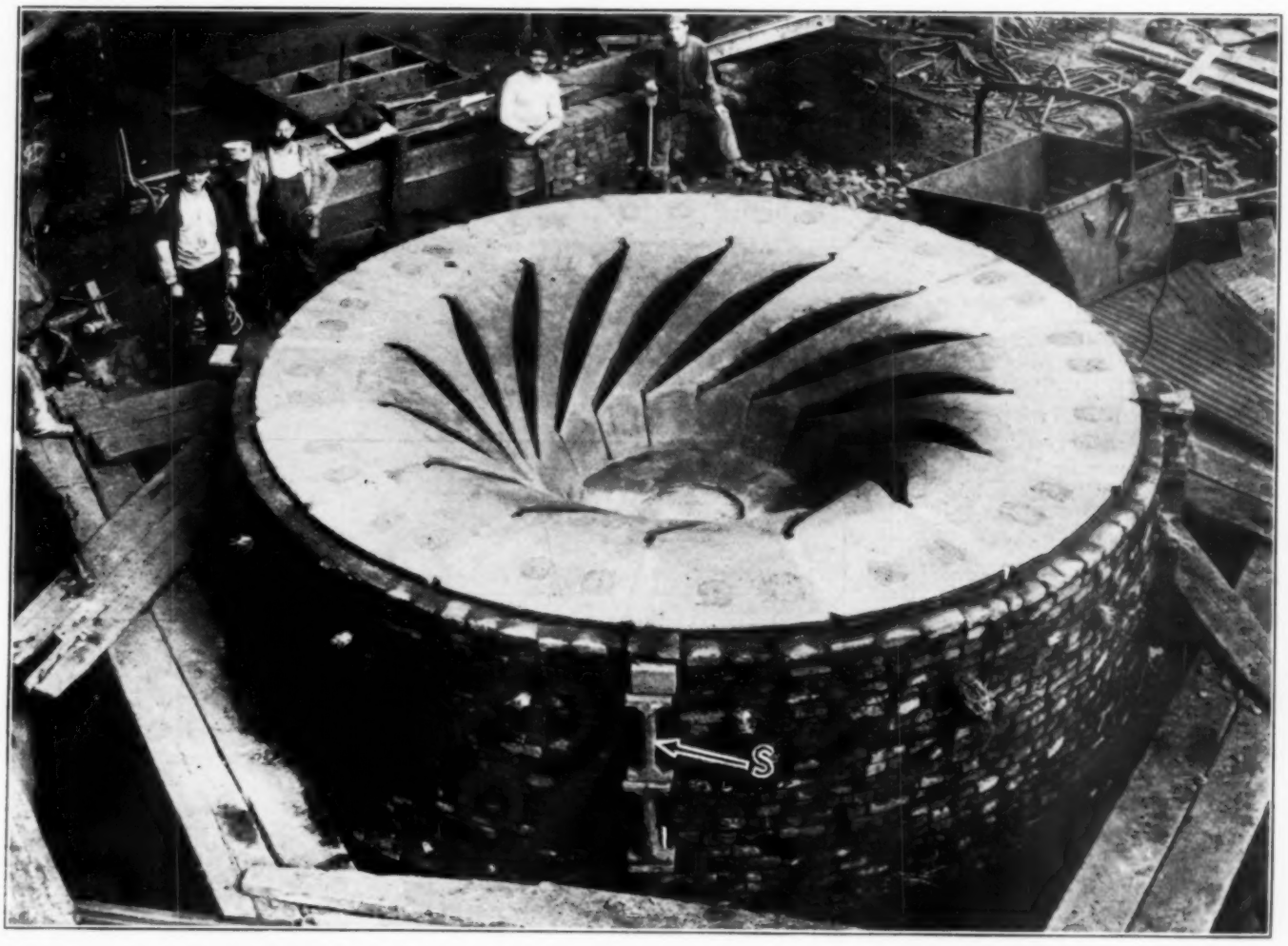


FIG. 6—A SINGLE BRICK WALL WAS BUILT UP AROUND THE OUTSIDE TO PROTECT THE CORES FROM THE LARGE AIR RAMMER SUSPENDED FROM THE CRANE—FOUR STANDARDS WERE BUILT UP FROM THE BOTTOM PLATE AT EQUIDISTANT POINTS TO SUPPORT THE WEIGHT OF THE COVER PLATE

up accurately horizontally and vertically, they were assembled on a planed iron plate and to provide a means of setting the last three cores, this plate was made in two equal parts. Thus it was possible to assemble nearly all the cores in a circle while the plates were together. Then the plates were forced apart with two hydraulic jacks, the remaining cores set after which the half plates were returned to their position together again. In preparing for the mold a hard level sand bed first was swept on the bottom of a pit about 5 feet deep. A heavy, cast-iron plate provided on its upper surface with two parallel machined guides was bedded down firm and level in the sand. A second plate made in halves as already stated, planed all over on one side and provided with suitable machined guides on the lower side was lowered into place, both halves of the plate tight together.

Circles were struck on the plate to define the position of the outside rims of the cores while radial lines drawn along the sides of the templet *D*, Fig. 3, served as guides in setting the sides of the vane cores. Beginning at one side at the parting line between the plates, the cores were lowered and adjusted in place, first the outside or supporting core and then the vane core which rested on it. Two successive stages in setting the cores are illustrated in Figs. 3 and 5. After 13 cores had been set, the two halves of the plate were jacked apart far enough to provide room for setting the remaining three cores. The manner in which the two cores projecting over the joint at each side while the plates remained apart were supported by double hooks and turnbuckles suspended from the crane, is shown in Fig. 5.

After the cores all had been set, the joints were daubed and the hook holes on the top filled with sand and slicked. Four standards, one of which is shown quite distinctly at *S*, Fig. 6, were built up with short sections of I-beams at four equidistant points on the circumference to support the weight of the cover. A single brick wall was built around the outside of the cores to insure them against being struck by the large air rammer suspended from the crane. Four long binder bolts were attached to each of the four sides of the foundation plate, after which the mold was surrounded by a sectional sheet steel curbing and the space between the curbing and the brick wall rammed solidly full of sand. Suitable stands on top of the cover plate were used to support the first set of four cast iron binders spaced equidistantly and parallel across the top of the mold. Four similar binders were laid transversely across the first set thus affording an opportunity for binding the mold together at 16 equidistant points on the circumference, or one bolt for each vane in the casting.

The binders were adjusted at a sufficient height above the cover plate to permit the construction of three runner basins, leading from three points outside the mold to a common center connected to the hub of the wheel by twelve 3¼-inch diameter gates. As stated in the article already referred to, the iron was melted in one cupola and poured from three ladles. The casting was allowed to remain in the sand for 10 days after it was poured to allow for a slow and gradual cooling and to prevent the development of contraction strains.

Proper Design Facilitates Molding

Closer Co-operation Between the Designer, the Draftsman and the Foundryman Is Bound To Result in Improved Shop Conditions, Lower Costs and Increased Production

BY F. C. EDWARDS

IN the drafting and designing room the foundry seldom receives the consideration to which it is entitled. Experience has proved that slight alterations in design which simplify the work of the molder frequently have eliminated potential sources of scrap and in many cases have resulted in reducing the cost of production. Stronger, cleaner and more accurate castings almost invariably are the result of conforming to the requirement of the foundry.

The following points although elementary often are overlooked and although their informative value may not be great, their neglect may affect production adversely and cause serious loss.

Where sand is rammed firmly against opposite parallel surfaces the enclosed object in this instance a pattern, is gripped as in a vise, which renders subsequent withdrawal a difficult operation for the molder and leaves the mold more or less disturbed. Therefore, in designing castings one should not hesitate to depart from square sections where taper sections will serve the purpose just as well. For instance the base plate with the section shown in Fig. 2 could be drawn from the sand much more easily than one with a section as shown in Fig. 1 and, another point, the mold would require less finishing.

In the foundry the *T* section shown in Fig. 3 always is preferred to that shown in Fig. 4. After the pattern has been withdrawn the edges of the mold at *AA* will be perfect, and the beauty of the rib *B* is apparent, —especially to the molder.

D-shaped facing pads or bosses which can be fastened permanently to the pattern give better results than circular ones which must be left loose for molding. The facing shown in Fig. 5 is preferable to the loos circular one shown in Fig. 6 if for no other reason than because it eliminates the delicate piece of overhanging sand at *X*. However, in addition the D-shaped facing also adds strength both to the pattern and the casting and finally loose pieces continually are either getting misplaced, left in the mold or lost.

Casting several units together with the laudable desire to save machining and assembling costs occasionally is carried to absurd lengths involving complicated and expensive patterns and special tackle in the foundry. Such a casting seldom is reliable because of the almost certain presence of internal strains set up by the conflicting forces of contraction while cooling. Figs. 7 and 8 illustrate a case in point which recently passed through the writer's hands.

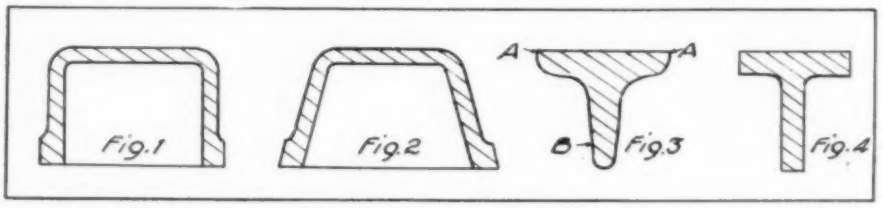
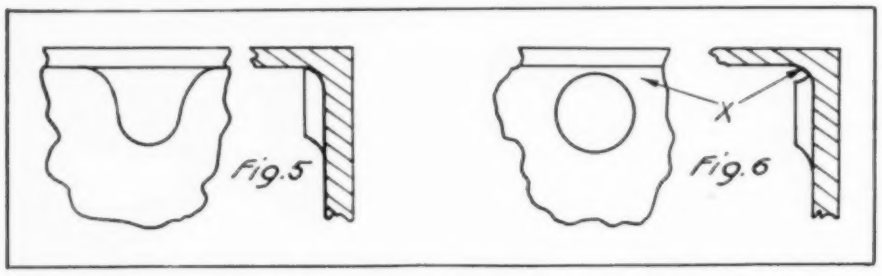


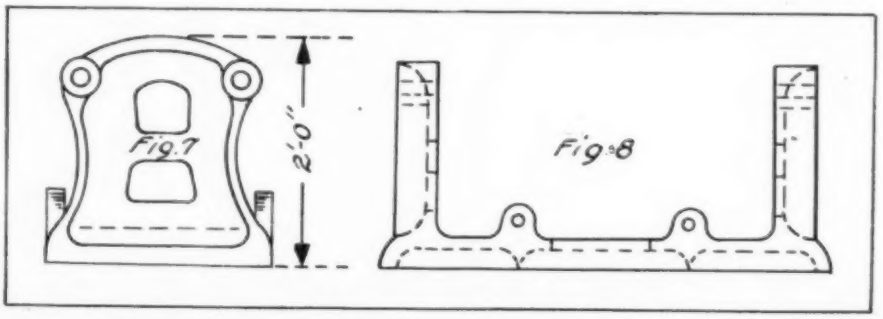
FIG. 1—USUAL DESIGN OF BASE PLATE FROM APPEARANCE OR UTILITY THIS SHAPE LENDS ITSELF MORE READILY TO THE MOLDER'S REQUIREMENTS FIG. 2—WITHOUT DETRACTING EITHER FIG. 3—THIS TYPICAL SECTION IS MORE EASILY MOLDED THAN THE SECTION SHOWN IN FIG. 4



FIGS. 5 AND 6—THE *D*-SHAPED FACING PAD IN FIG. 5 IS PREFERABLE TO THE LOOSE CIRCULAR PAD SHOWN IN FIG. 6

An examination of the blueprint indicated that a somewhat bulky pattern and corebox would be required. After a little discussion it was decided to make two patterns, one for the end and the other for the base plate and thus dispense with a corebox. The ends were alike so it was only necessary to make two castings off the one pattern and since the pattern was molded horizontally it left its own core. Suitable connecting lugs were provided on each pattern and after the castings had been made they were machined and assembled. The job proved to be satisfactory in every way and even with the extra machining and assembling the cost was less than if the original method had been adopted.

While watching molders laboriously tugging at stubborn patterns the thought often has occurred to the writer that if a patternmaker had to



FIGS. 7 AND 8—SIDE AND END ELEVATION OF A JOB THAT WAS MOLDED TO ADVANTAGE BY MAKING TWO SEPARATE PATTERNS

mold his own pattern he soon would develop a respectable amount of the fellow feeling which it has been said makes the whole world kin. Although molders, like members of the so-called learned professions occasionally differ in opinion they all subscribe to certain fundamental principles.

A patternmaker should not rely on his own opinion too implicitly when deciding how a certain pattern should be molded. Where there exists the slightest doubt the molder should be consulted and his opinion should be accepted as final. He is responsible for the casting and in any event he is more familiar than the patternmaker with the boxes and rigging.

Pattern parts should not be doweled together ambiguously or in such a manner that they may easily be misplaced and yet apparently fit according to the dowels. The relative positions generally can be arranged in such a manner that if the dowels happen to fit with the parts wrongly positioned the mistake will be so glaringly evident as to attract attention. The better plan is to use a different size dowel in each hole and then, of course, all possibility of error is obviated.

Cores with similar prints but not otherwise symmetrical frequently are placed in the mold *end for end.* The molder is not endowed with special powers of divination even if he is observant or lucky enough to note that the core is not symmetrical. In cases of this character the prints should be clearly differentiated by some means such as cutting a fair-sized corner off one print and placing a corresponding piece in the corebox. The difference between the two prints should be tangible and evident because the print in the bottom of a deep mold frequently is not as distinct as it might be.

Wherever possible any surfaces on the casting to be machined should be indicated on the pattern and if practicable that side should be molded down. It might be easier to mold it the other side up but occasionally it is the part of wisdom to subordinate ease of molding to other factors. Clean castings, close in texture, and free from porous areas cut down the percentage of machine shop rejections.

Loose pieces on the the pattern apparently sometimes are dealt with on the assumption that the molder has as intimate a knowledge of the job as the patternmaker who has studied the blueprint for days and in some cases for weeks. They should be numbered and their positions quite plainly marked. Wherever practicable loose pieces should be attached by dove tails. This method is preferable to using nails, wires or wooden pegs. The molder generally pulls the nail before he has completely covered the loose piece and for this reason it frequently becomes shifted from subsequent ramming. The patternmaker may claim that the piece was located in its proper position when the pattern left the pattern shop but that does not relieve him of all blame if he has not anticipated a possible shift and adopted the necessary means to prevent it.

In the construction of a pattern the best all-around results are not secured through a too literal translation of the drawing. To quote from the late Mr. Gladstone "It is bad to give a too complete submission to authority."

Technical Program Prepared for Rochester

AN EXTENSIVE program of technical papers and reports has been prepared for the American Foundrymen's Association convention to be held at Rochester, N. Y., from June 5 to 9. The coming convention will be of an international character, for in addition to the annual exchange paper of the Institution of British Foundrymen which will be read by F. J. Cook, of the British Institute, two papers are being contributed by members of the French Foundrymen's association and one by the president of the Belgian Association of Foundrymen.

One session will be devoted exclusively to papers and reports of the jont American Foundrymen's Association and National Research Council committee on molding sand research. While the work of the committee has only been carried through its preliminary stages, many interesting facts have been uncovered regarding reclamation of old molding sand and methods of testing sand.

The industrial relations session has been planned to feature foremanship, safety work and education of foundry workers. As has been the custom for the past few years, a joint nonferrous session will be held with the Institute of Metals division of the A. I. M. M. E. The nonferrous session of the American Foundrymen's Association will be devoted largely to papers and discussion of the problems of the aluminum castings manufacturer. At this time it is hoped to bring together a large number of men interested in this increasingly important branch of the foundry industry.

An important part of several of the sessions will be the reports of the A. F. A. committees which have been working with the American Society for Testing Materials to better the standard specifications of casting metals. In all, about 45 papers have been secured for the eight technical sessions.

Titles of papers, together with the authors who will present them, exclusive of those prepared for the nonferrous sessions, follow:

Flask Equipment for Molding Machines, by Arnold Lenz, Saginaw Products Co., Saginaw, Mich.

A Study of the Weight of Iron Castings, by J. D. Wise, Osborn Mfg. Co., Cleveland.

Electrically Heated Metal Patterns, by C. A. Cremer, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Investigations Relative to Insulated Core Oven Design and Performance, by C. F. Mayer, Ohio Body & Blower Co., Cleveland.

Belgian Method of Making Typewriter Frames, by J. Leonard, Liege, Belgium, president, Belgian Foundrymen's association.

Design of Geared Ladles, by A. W. Gregg, Whiting Corp., Harvey, Ill.

Electric Cranes in Foundry Service, by A. H. McDougall, Whiting Corp., Harvey, Ill.

Accurate Control of Analyses in Acid Electric Steel Furnaces, by A. C. Jones, Electric Steel Co., Chicago.

Proportions of Clay and Flour in Facings for Steel Castings, by R. J. Doty, Sivyer Steel Casting Co., Milwaukee.

Progress in Open Hearth Process, by Willis McKee, Arthur G. McKee Co., Cleveland.

Side Blown Converters, by T. Levoz, metallurgist, Auxonne, France.

Tests and Cerium as a Deoxidizer and Desulphurizer in Red Brass, Cast Iron and Converter Steel, by L. W. Spring, Crane Co., Chicago.

Impact Tests on Steel, by F. C. Langenburg, Watertown arsenal, Watertown, Mass.

Manufacture of Manganese Steel in the Electric Furnace, by John Howe Hall, Taylor-Wharton Iron & Steel Co., High Bridge, N. J.

Research in the Foundry, by A. E. White, University of Michigan, Ann Arbor, Mich.

Eye Protection and Safe Clothing in the Foundry, by Buell W. Nutt, Safety Equipment Service Co., Cleveland.

Time Study Applied to Foundry Practice, by A. J. Kramer, Deering works, International Harvester Co., Chicago.

The Preparation of Steel Foundry Sand, by S. H. Cleland, National Engineering Co., Chicago.

Tests of Molding Sand, by R. J. Doty, Sivyer Steel Casting Co., Milwaukee.

The Significance of the Screen Tests of Molding Sand, by H. A. Schwartz, National Malleable Castings Co., Cleveland.

Relation of Temperature to the Form and Character of Graphite Particles in the Graphitization of White Cast Iron, by E. J. C. Fisher, Atlas Die Casting Co., Worcester, Mass.

The Behavior of Fire Brick in Malleable Furnace Bungs, by H. G. Schurecht, United States bureau of mines, Columbus, O.

The Manufacture and Properties of Refractories for Air Furnaces, by C. E. Bales, Louisville Fire Brick Co., Highland Park, Ky.

Carbon Dioxide Recorders, by D. M. Scott, T. H. Symington Co., Rochester, N. Y.

Use of Oil as a Fuel for Melting Malleable Cast Iron, by S. Mackey and W. Hoernke, Stowell Co., Milwaukee.

Tests on Cast Iron, by R. S. McPherran, Allis-Chalmers Mfg. Co., Milwaukee.

Steel Castings Versus Malleable Castings, by J. W. McKeon, West Michigan Steel Foundry Co., Muskegon, Mich.

Technical School Foundries, by Prof. J. D. Hoffman and R. E. Wendt, Purdue university, Lafayette, Ind.

Exchange paper of The Institute of British Foundrymen, by F. J. Cook, of the Institute of British Foundrymen. The subject of Mr. Cook's paper has not been received.

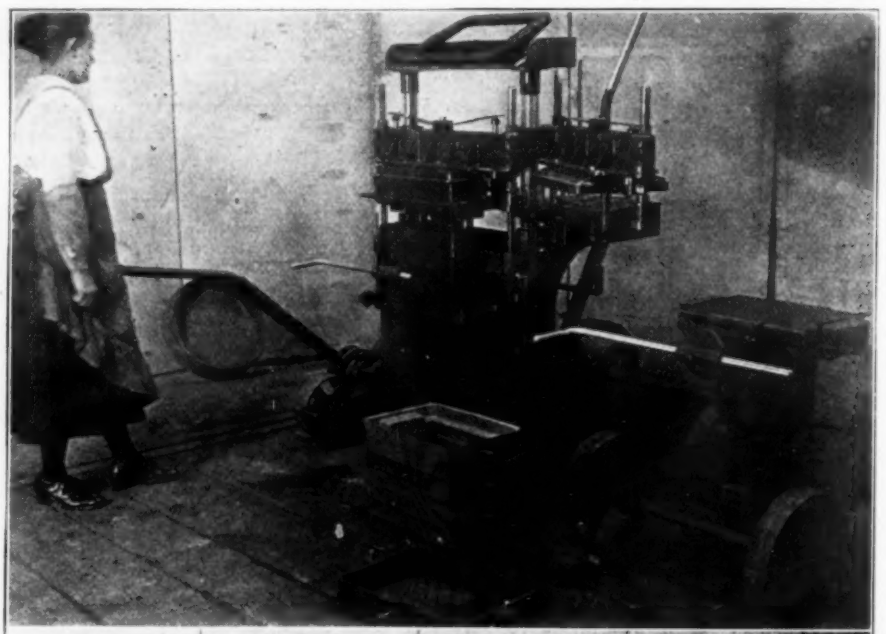
Exhibits a German Molding Machine

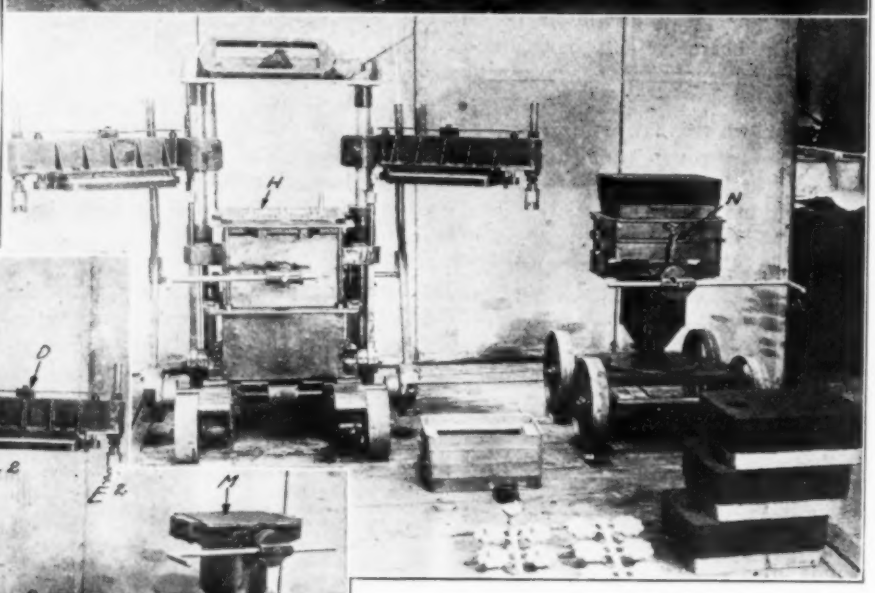
This Hand Operated Portable Machine Provided with Two Squeezing Heads Operated Independently of Each Other Produces a Pattern Impression on Both Sides of the Mold

THE Vereinigste Schmirgel & Maschinenfabriken, A. G., Hannover-Hainholz, had on exhibition at the recent Foundry exhibition in Liege, Belgium, an interesting type of portable molding machine designed to be operated by hand power and which may be employed either for making single or multiple molds in which several molds are stacked one on top of another and all poured through a single runner. The machine shown in the accompanying illustrations comprises a cast iron frame mounted on four wheels. An upright steel pillar on each side supports a swinging squeezing head against which the flask full of sand is pressed by either of the long upright levers shown at each side. Each lever is mounted independently and the force applied to the end is transmitted through a crank arm adjustment which it is claimed exerts a maximum pressure on the mold with a minimum effort on the part of the operator.

Another interesting feature in connection with this machine is that instead of employing flasks a frame is rammed up in the drag, corresponding to the frames used in American snap flask practice. The frame in this instance serves a further purpose than merely reinforcing the sand around the mold cavity. It is provided with an interior sand strip all around and also with a pair of hand grips, one at each end and is used to strip the completed mold from the flask in which it is made and also to carry it to its appointed place on the foundry floor. In this manner only one pair of matched flasks is required, but a frame must be provided for every mold. The flask is shown at *A* and the frames at *B* in the illustration Fig. 5.

Where the molds are to be poured individually, or stacked as shown at the extreme right in Fig. 3, both right and left hand squeezing heads of the machine are employed to make them; but where the molds are to be stacked straight with a common runner leading to every mold, the left hand squeezing head alone is employed. The left hand squeezing head is provided with





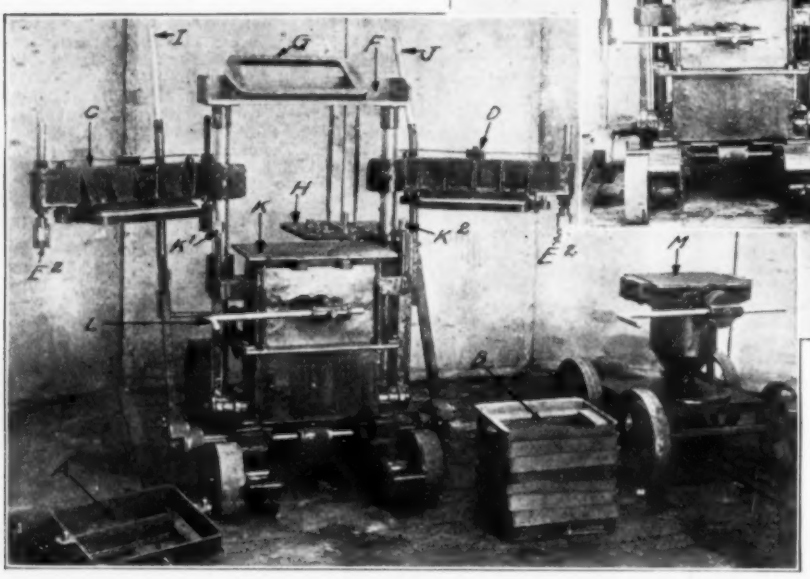


FIG. 1—THE MACHINE IS PROVIDED WITH TWO PATTERN PLATES, ONE ATTACHED BY A SWINGING ARM TO THE RIGHT HAND COLUMN AND THE OTHER TO THE LEFT HAND SQUEEZER HEAD FIG. 2—SQUEEZING THE DRAG FIG. 3—STRIPPING THE MOLD OUT OF THE FLASK

FIG. 4—THE DRAG IMPRESSION IS PRODUCED BY PRESSING A PATTERN PLATE AGAINST THE UPPER OR JOINT FACE THUS RELIEVING THE OPERATOR OF THE NECESSITY OF ROLLING OVER THE FLASK. THE COPE IS SQUEEZED IN THE USUAL MANNER

a pattern plate while the right hand plate is plain and flat.

The cope and drag flasks shown at *A*, Fig. 1 are alike, provided with pins on the lower joint and pin holes on the upper joint. They are interchangeable and may be used in either position. Cope and drag are only relative terms since these frames are only used to form the blocks of sand forming the molds. They are removed from each mold as it is made and set back on the machine to form the succeeding mold.

Operation of Machine

With the machine in the position shown in Fig. 1, one of the flask frames is placed on the table of the machine where suitable pin holes locate the flask in its proper relative position. One of the frames *B* is placed inside the flask, the frame *G* is placed around the top of the flask which then is filled with sand and scraped off level. The squeezing head *C* with pattern plate attached, but not visible in the illustration, then is swung around through approximately 180 degrees until the catch *E*1 locks on the anchor *K*2. The lever *I* is pulled down which raises the table and presses the soft sand face against the squeezer head. The frame *G* is designed to hold just the proper amount of excess sand to compensate for the pressure exerted and the space occupied by the patterns.

When the operator releases the lever *I* the table carrying the flask sinks back to its original position. The squeezing head then is swung around out of the way and the flask which in this instance constitutes the drag half of the mold is lifted off and placed on a small stripping transfer machine *M* shown alongside the molding machine in the various illustrations.

The cope pattern plate *H*, attached to the right hand post of the machine by a swinging arm is pulled around until it rests on the table of the machine. The cope flask is set on and located by suitable pins as in the case of the drag. The flask is filled with sand and squeezed by the plain head *D* in the manner described for the drag. However in this instance the right hand lever *J* is employed and the lock *E*2 anchors on the bolt head *K*1. The lever handle *L* operates four long pins, one at each corner, which lift the flask high enough to clear the patterns. This operation is illustrated in Fig.5. This part of the mold constitutes the cope and at this point is lifted off and set on the drag.

The device shown at *M* is self explanatory. The assembled flask is held in position by two clamps, one of which is shown at *N* Fig. 3 hooked over a pin cast in the side of the flask. The long lever handle is reversed from left to right and the action forces the mold out through the top of the flask. It then is picked up by the frame which was rammed in the drag and which forms an integral part of the mold.

FIG. 5—FOUR SMALL PLUNGERS, ONE AT EACH OF THE FOUR CORNERS AND ACTUATED BY A LEVER ON THE SIDE RAISE THE COPE FLASK HIGH ENOUGH TO CLEAR THE PATTERNS

Pattern Design Presents Problems-II

Pattern Construction Desirable and Economical from a Pattern Shop View Point May Well Be Highly Expensive on Account of Subsequent Foundry and Machine Shop Costs

BY JOSEPH HORNER

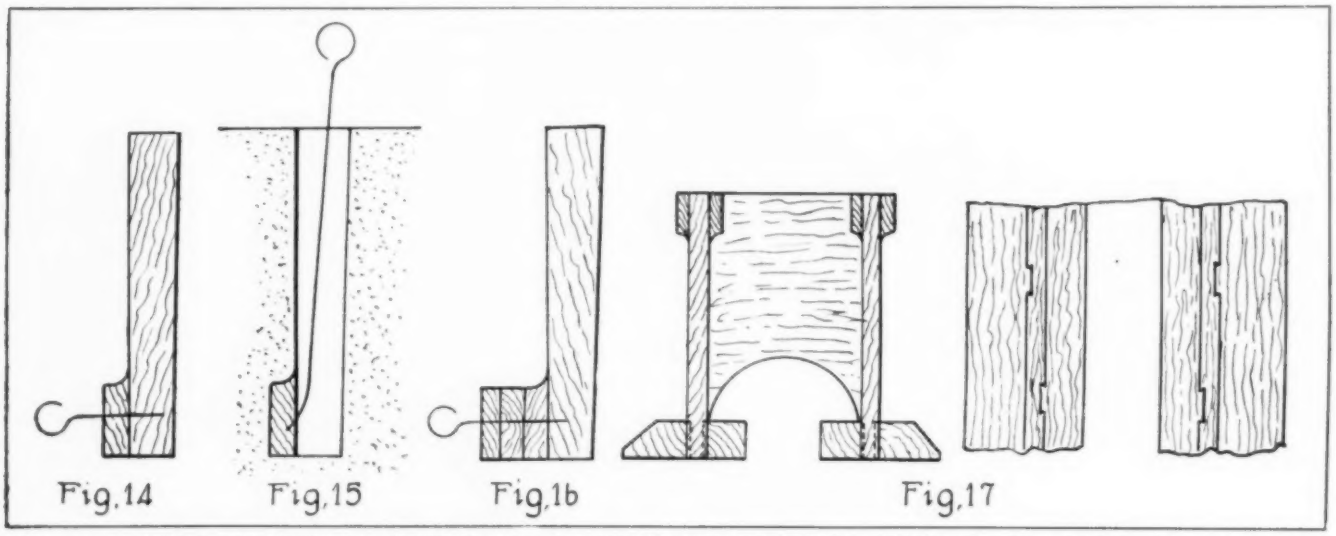
INACCURACIES of patterns, or portions of patterns or coreboxes is a common cause of trouble. The desire not to incur unnecessary expense always is present to the mind and generally is laudable; but this should not be carried so far as to throw excessive cost either upon the foundry, or machine shop. The question of cost is one that depends on circumstances. A roughly-made pattern may be good enough to serve its purpose. A highly finished one may be economically undesirable. The question is one of means to an end. It is concerned with design and construction more than with finish. That is the best pattern which best fulfils its function, suitably to the number of castings required from it.

A good pattern must deliver well and retain its correct shape for the period of its service, whether short, or prolonged. Questions arise of jointing, of loose pieces, of taper, and delivery, of the place and extent of coring, of the materials to be employed, and of the methods of construction. These in the aggregate open a wide field for variations in methods of working, all related to the accuracy and the uniformity of the castings produced.

Questions that concern methods of jointing only can be determined with reference to the shapes of individual patterns where jointing is the alternative to solid constructions. The joint often is omitted in casual jobs to lessen pattern work. Then extra labor may be thrown on the molder, either in down-jointing of sand to lift in the cope, with some risk of fracture, and delays and inaccuracies in mending up, or in some instances it will involve the use of drawbacks, or grids to carry the masses of sand, in preference to down-jointing. The cost and delay and sometimes unsatisfactory character of these methods must be set off against the saving of expense in the pattern work. These devices also may increase the work of the machinist where they detract from the accuracy of the castings. A mold awkwardly jointed, in which the sand has been fractured and mended up, or one with loose drawback plates set with sand joints, is more liable to produce inaccurate castings than one made from a properly jointed pattern.

Draft is Necessary

Taper and delivery are inseparable. A molder desires plenty of draft, and grumbles if a pattern has too small an amount. Where parts have to be machined, an excessive amount increases the work of tooling and the patternmaker gets the blame. A general rule is to give ample taper to details that are not working parts, such as ribs, bosses, and faces that are not to be tooled, and as the inner faces of many flanges, and to impart the minimum elsewhere. The draft in the cope parts of a pattern usually can be reduced by leaving them loose, even where they do not coincide with necessary pattern joints. Ribs and bosses commonly are treated thus. Being lifted with the cope sand, and withdrawn after the cope is turned over, they need have but a slight amount of taper, much less than if the sand were lifted off them. Bosses and ribs, well tapered, have a better appearance than those of parallel thickness. When they are made fast in copes, the molder frequently will unscrew them to mend the mold.



FIGS. 14, 15 AND 16 ILLUSTRATE METHODS OF ATTACHING AND REMOVING STRIPS TO AND FROM THE BOTTOM OF DEEP PATTERNS. FIG. 17—WHERE PRACTICAL A DOVE TAIL JOINT INSURES GREATER ACCURACY

A pattern having little draft requires much rapping, the amount and severity increasing with depth of lift. This causes some enlargement of the upper sections of the mold adjacent to the joint face, and of the casting. If rapping and lifting holes are made directly in the pattern by the molder, they soon cause damage, and conduce to inaccuracy. To prevent this, rapping and lifting plates of metal should be inserted. For extra deep patterns lifting straps are helpful.

An objection to jointed patterns is, that the parts are liable to become shifted after prolonged service, causing overlapping joints in pattern parts and in their castings. In brass molders' small work, the patterns seldom are

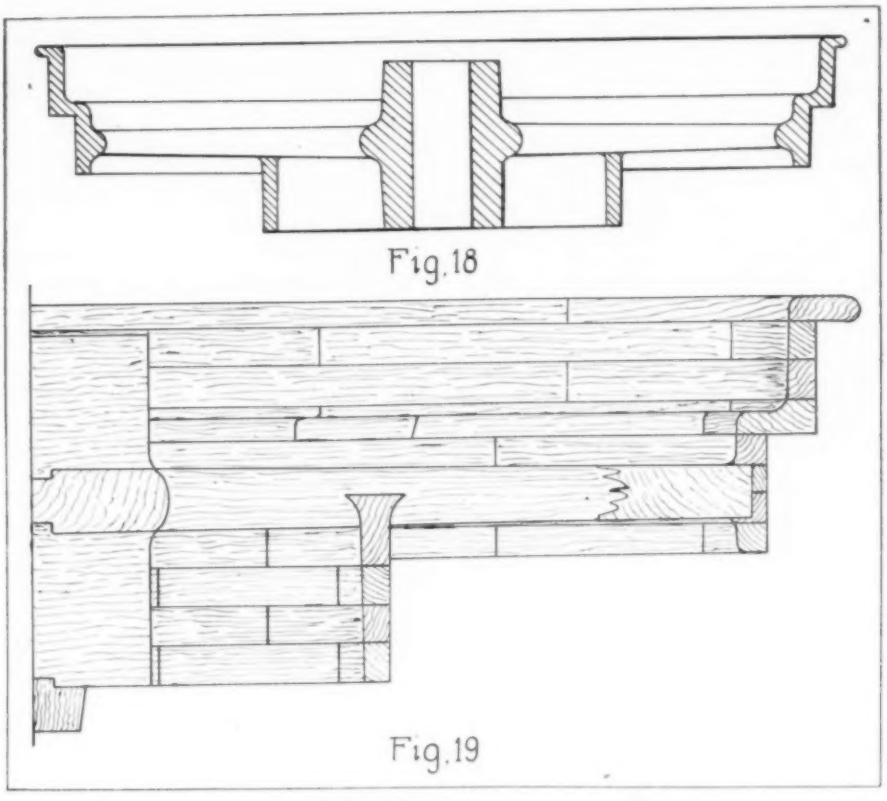


FIG. 18—THREE-STEP PULLEY CASTING. FIG. 19—PATTERN CONSTRUCTION DETAIL FOR CASTING SHOWN IN FIG. 18

jointed, but recessed boards, and odd-sides commonly are used. This is not practicable with the larger patterns of the iron foundry. To prevent lap joints, metal dowells are better than those of wood, which become worn and slack by the constant attrition of sand. Lapping joints will occur if the box pins and holes wear. The molder must look to this. Lap joints in castings not only have an unsightly appearance, but they will, in some instances, give an excess for tooling in one part, and leave little or nothing in another.

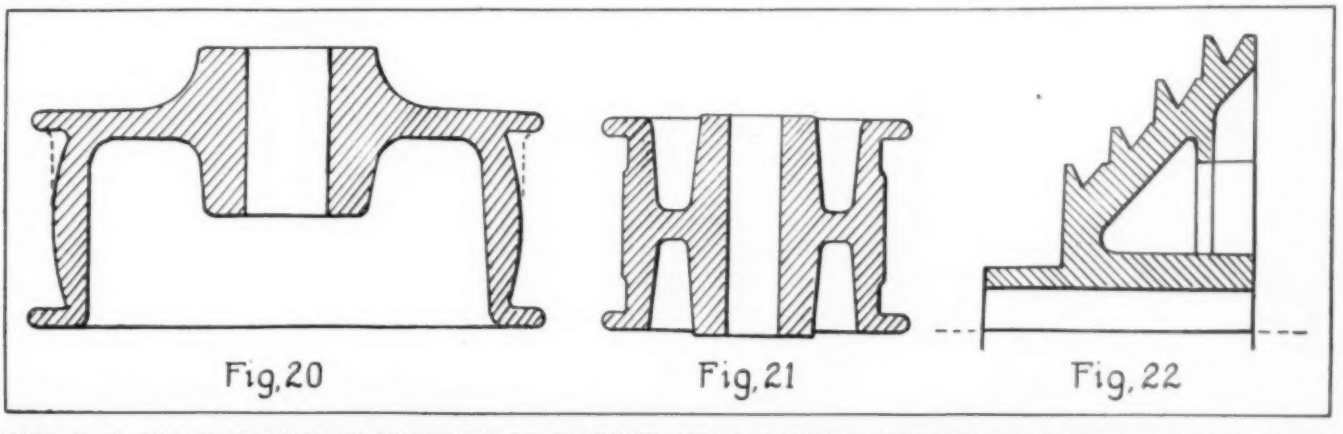
Loose pieces may cause trouble from two causes, inaccurate molds, incidental to their employment, and their chance omission from the pattern. Since these pieces are not attached permanently and firmly to their patterns, but only with skewers, dowells, or dovetails, they are liable to be rammed out of place; not to a large extent, but sufficient to detract from the accuracy desirable. They will become tilted, pushed over, or bodily moved a little after the removal of skewers, and where they are in the lower portions of molds a moderate amount of shifting is not noticeable. Neither is mending-up easy if the sand should break down during the withdrawal of such pieces.

The patternmaker should avoid putting on loose pieces at random, regardless of whether they can be removed readily, and if withdrawn, whether the mold section can be mended, cleaned, or blackened. Fig. 14 illustrates a suitable case for loose pieces situated deep down in a thin web. They are removed as in Fig. 15. Obviously, the loose pieces in Fig. 16, though divided, must cause trouble, and therefore some other method should be adopted, such as a covering core, or a little drawback. If a thin rib space, a clear open, or a central space exists, then the strip can be used as in Fig. 16, but it will not be necessary to make the divisions shown, since a single solid strip can be drawn in. In this case the limit is about reached, because, though a wider strip, well tapered, might be withdrawn, mending-up and blackening become troublesome, due to the awkwardness of the situation. A loose piece of large width or diameter is more favorable to delivery and cleaning than the rather thin strip shown.

Methods of Construction

The omission of loose pieces from a pattern sometimes occurs when they are of small dimensions and there is no indication of their presence except small skewer holes. These, in old patterns, may have become filled with sand, and be mistaken for marks left by the vent wire. The risk of omission can be prevented if a cross, or a figure, or a letter is cut or stamped on the locality where the loose piece belongs to indicate its presence. Better still, the loose piece fitted with dovetails, as in Fig. 17, cannot be overlooked. However, these are only available on the lower portions of patterns.

Methods of construction vary exceedingly. The selection depends chiefly on the numbers of castings required from a pattern, in which case permanence of form is essential. Here, the methods of the carpenter and joiner are supplemented by those peculiar to pattern work. Wood and



FIGS. 20, 21 AND 22 ILLUSTRATE EXAMPLES OF CROWNED AND GROOVED WHEELS IN WHICH IT USUALLY IS ADVISABLE TO MAKE THE FACE OF THE PATTERN STRAIGHT AND AFTERWARD CUT THE CROWN OR GROOVES IN THE MACHINE SHOP

metal both are used for materials the latter for length of service only, and for sections which are of a flimsy character. Hard woods occupy a middle place between the softer kinds and metal. Construction and

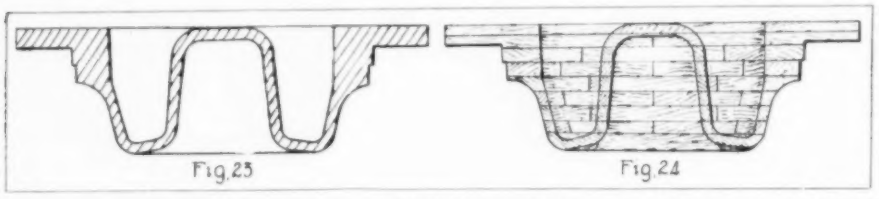


FIG. 23—A COMMON TYPE OF CYLINDER HEAD. FIG. 24—WHERE A LIMITED NUMBER OF CASTINGS ARE REQUIRED A WOODEN PATTERN BUILT UP IN SEGMENTS WILL PROVE SATISFACTORY

materials are related. The choice is determined largely by dimensions, substance, strength, and by permanence of form, which again is related to the numbers of molds to be made.

Patterns of wood built up in segments have a comparatively long life, especially if they are smoothed at intervals with glass paper, and revarnished. It seems hardly necessary to state that the advantages gained by building up are the localization and practical elimination of shrinkage effects, of vastly increased strength over that of patterns cut from the solid, and the retention of shape under the severe character of foundry conditions. Details of building up vary with different kinds and sizes of patterns, including segmental and sector shapes, open joints, lagging strips, and boxed-up bodies; each in many variations. In some cases lumber is saved, in others not, but economy in this direction is not the primary consideration except in the last two cases named, in which it is still associated with retention of shape. The principal factor considered is the retention of correct outlines, and of strength for an extended period.

Fig. 18 illustrates a casting of from 3 feet to 4 feet diameter, the pattern for which must be built up as shown in Fig. 19. There is no practicable alternative. If a large number of castings were required, an iron pattern would be suitable. The mold could be made by sweeping, and the insertion of arms, or loose arms, might be fitted. Apart from this exceptional method Fig. 19 shows the best pattern construction. Three belt steps are to be built up with sector pieces. The arms are locked together at the center and let into the rim in the course of building the latter. Bosses are centered with studs.

It may be noticed that although the belt steps have to be crowned, they are straight in the pattern. If they were curved, the molder properly would refuse to mold from the pattern unless the crowning was removed. Wherever there is a considerable amount of curving in a pulley, or a fly wheel, if that is put on the pattern, it involves a mold joint in the middle plane. If flanges are included as in Fig. 20, these make matters worse, because both flanges then have to be left loose. A ring core would get round the difficulty in a fashion; but that would not commend itself, and it would be an expensive solution. It is better to make such patterns with straight treads, or at least straight above the center as shown, and let all the crowning be done in the machine shop. This is the general practice in belt pulleys which are molded straight inside and outside, leaving the crowning to be turned in the machine shop. Fly wheels are better if made straight-faced, where full patterns are made by ordinary methods. Where halves are plated and put on opposite sides of one plate, or on separate plates, then the crowning is included, but this would not be applicable in Figs. 18 or 20.

Fig. 21 is a crane wheel with a raised tread to be turned to make smooth contact with the rails. The pattern either is made like its castings, or the entire space between the flanges is turned. Then the tread is made continuous and one flange only is left loose. On the whole the better way is to joint the pattern along the middle plane and leave both flanges loose. This means a special four-part box, to which there is no objection, when these are required in large numbers.

Akin to these examples is the pulley, shown in Fig. 22, to be grooved for ropes. The grooves are not put in the pattern, which molds with the axis of the pulley vertically. It is possible to include them if the pattern lies with the axis horizontally, the halves going in top and bottom boxes, but that would be unsatisfactory, with no counteracting advantage, since it is easier for the lathe man to turn the grooves from the solid, than to scrape up cast grooves.

Casting solidly may be carried to excess. It is customary to cast the rims of gear wheels in solid form when the teeth are to be cut in them. With heavy pitches, this masses too much metal in the rim, straining and weakening the wheel, and resulting in distortion after the teeth are cut, especially when the casting is made of steel. In such cases it is better to cast the teeth full large than to have a continuous thick rim.

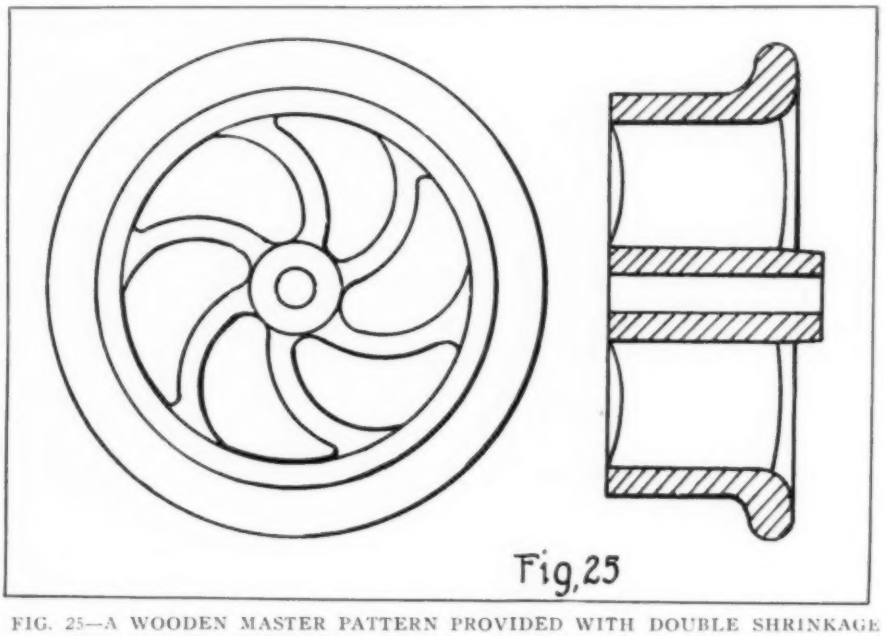


FIG. 25—A WOODEN MASTER PATTERN PROVIDED WITH DOUBLE SHRINKAGE AND FINISH ON THE RIM USUALLY IS MADE FOR THIS TYPE OF MINE CAR WHEEL—FROM THE MASTER PATTERN ONE OR MORE IRON PATTERNS CAN BE MADE FOR USE IN THE FOUNDRY

Fig. 23 shows a cylinder cover. A pattern of wood is suitable for this, constructed with courses of sectors as shown in Fig. 24. Every part will deliver freely, and there are no complications. It is of no importance which face is molded down, since

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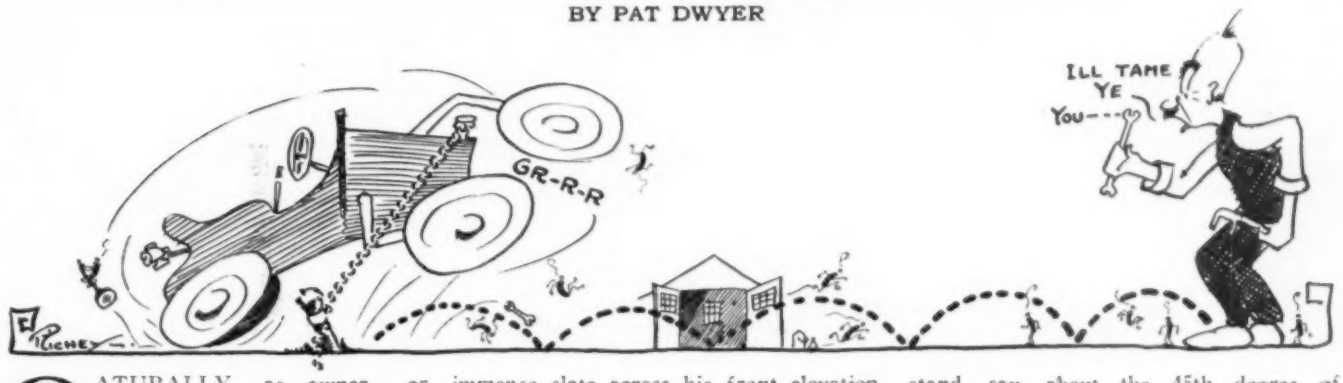
Bill On Pattern Mounting Methods--VI

BY PAT DWYER



NATURALLY as owner, or prospective owner, depending on how long and successfully you have been meeting the monthly installments, you feel perfectly justified in referring to it as the old bus, the old boat, the rattler and the ice wagon. Terms of endearment and familiarity, of course, and never intended to be taken at their face value or construed literally. In fact, the same terms employed by another party properly are classified as coming under the general heading, *gratuitous insult*, and as such they are resented bitterly. In a large, generous and expansive mood, with the milk of human kindness fairly oozing from every pore and dripping figuratively from the finger tips, you inform your friend that the old cement mixer can do 30 miles on a gallon of gas. If the friend cynically comments, as friends have been known to comment, in a loud voice, that the old rattle trap probably only was hitting on one of the four cylinders most of the time, that same milk of human kindness becomes curdled and sour and you experience a venomous desire to spray the one time friend with molten lead or concentrated essence of sulphuric acid. For a second choice you toy prospectively with the pleasure to be derived from pouring melted pitch down the back of his neck, or suspending him on the crane hook above a 10-ton ladle until he had turned a crisp and juicy brown. Since the personal element is not involved, there is no valid reason why an outsider cannot discuss the question in an abstract manner and therefore we have no hesitation in employing any term which at the moment seems most appropriate. All of which merely is a prelude leading up to the statement that each time you drove the old wash boiler past a certain filling station in your town, you slowed her down long enough to read the message presented by the pop-eyed young man holding an immense slate across his front elevation.

Apparently, the artist who designed and executed this classic bit of landscape adornment had his inspiration from the movies where the actor's relative importance is gaged by the extent to which he can expose the whites of his eyes. In especially tense bits, of course, where every ounce of technique is called into play, the more highly skilled of these trained and talented artists, gasp, slide the good old Adam's apple up and down and clinch the hands. No sub-titles are permitted at these critical stages. The gripping message is put across in a great big way in a truly dramatic manner by a close-up in which the course of the apple distinctly may be noted, followed by a second close-up showing the hands slowly assuming an appearance reminiscent of an old barn yard rooster that has died from a combined attack of pip and the colly-wabbles.

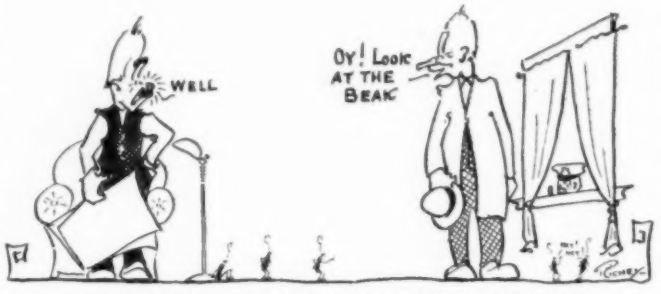
The heroine, through natural physical limitations, is barred from displaying her emotions through the medium of apple bobbing. The fact that she is first, last and all the time a lady prevents her from clinching her fists. Besides rings do not show to advantage while the fingers are doubled and beautifully pointed finger nails never were intended to be concealed from an eye-hungry public. She presents a faithful portrayal of each and every emotion by breathing hurriedly for ten or fifteen seconds, clasping both hands in front of her heaving bosom, not too high you understand, say, about the 45th degree of north latitude, and by throwing both eyes into high.

About this time it is quite in order for the indignant reader to rise up on his hind legs, snort loudly through one, or both nostrils, depending on whether he is equipped with a single or twin snorter and demand loudly, what in the Sam Hill—or other favorite form of invocation—what the Sam Hill the bulletin board in front of a filling station has to do with the movies and further, what possible connection exists between pop-eyed young gents concealed behind slates and methods for mounting patterns. Steady old dear and all that bally kind of thing. Keep your hair on for a minute and do not try to rush the hearse, the mourners are on foot.

While passing a station in one of my electrics the other day, I read a message on the bulletin board which seemed to have been written for my particular benefit. Had I been at the wheel I probably should have slowed down and read the message over a few times, but my driver for the time, No. 2407 apparently had urgent business at the other end of the line. He paid no attention to signs along the street. He kept his eyes straight ahead, munched away on a mouthful of fine cut with all the technique, speed and regularity of a billy goat and seemingly derived a certain fiendish pleasure in beating out a continual clamor from the gong under one of his slightly run down but still highly competent heels. 'Twas all I could do to read the message by craning my neck around, before the car had borne me—and 60 or 70 other passengers, seated and standing in the tonneau—out of sight. Under ordinary circumstances I should have read the message, mentally classified it as a rather clever jape and then probably have forgotten it; but on this particular morning, my nose, through some form of infec-

COME CHILDREN ALL TOGETHER "THE FATAL NOSE OF RED"

tion, had assumed the general shape, size and color of a ripe tomato. I was deeply embarrassed through the necessity of flaunting such a feature publicly; but a nose is something that does not lend itself readily to concealment. It is not one of those rare flowers born to blush unseen and waste its sweetness on the desert air. Any attempt to cover it with a shield, probably would attract more attention than if it was left alone and, so far as I know, no attempt ever has been made to carry it in a sling. I had listened to many supposedly humorous comments, but the climax was reached when I read the sign on the filling station bulletin board: "Be it ever so homely, there is no face like your own." A number of friends professed to be shocked at what they were pleased to term the evidence of a double life. Others drew me aside confidentially and begged me in mock seriousness to disclose the address of my favorite bootlegger. One Job's comforter told me that on a certain Monday morning not long ago he had talked with a man whose nose was not nearly so violent looking as mine and on the following Monday he had helped to lay the remains away in Lakeview cemetery. Usually one does not expect an over-display of sympathy from ordinary acquaintances, or from those associated in work day activities, but surely one is justified in anticipating a certain degree of sympathy from the members of one's own family. I must confess that I was disappointed. The lady who now represents the high justice, the middle and the low, at one time promised to love, honor and obey me. On the first point she refuses to comment and occasionally has me guessing, but the two remaining clauses in the contract she definitely discarded many years ago. She has not the proper degree of awe and respect which a well trained wife should have for the titular head of the house. She scoffs openly, and if the truth must be told, with ease and fluency, at the terms lord and master. She refused to considered my bulbuous nose as a subject for sympathy and suggested, somewhat flippantly I thought, that in future I keep it out of other people's business. Remarks of that character I could and did, treat with a dignified silence. It was much more difficult to ignore the guarded glances, nudges and half suppressed giggling of those ungrateful young creatures listed in the income tax forms, as dependent minors; but when the baby threw away her toys, set up a howl and insisted that I let her play with it, I felt that I had reached the jumping-off place. I was seriously considering the advisability of adopting some strong arm stuff and was mentally debating the relative merits of a nice hefty little hammer and a 3-foot length of inch pipe, when Bill came in and created a diversion.



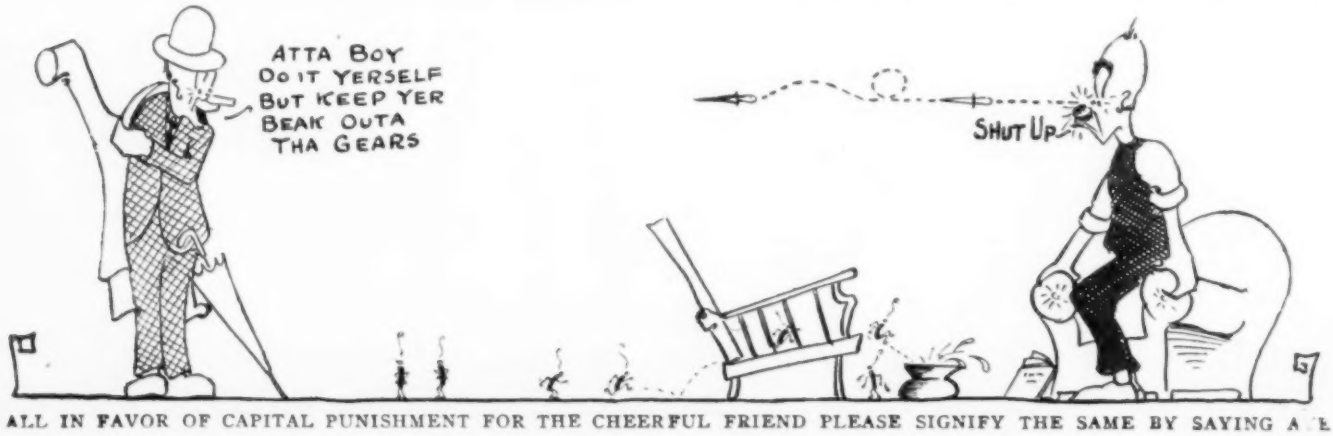
YOU SAID IT POICY, AINT NATURE GRAND?

"What a beak!" said he. "What a beak! I'll tell this little whirling globe on which we live and move and have our being, that not even in the days preceding Mr. Volstead, have I seen its equal. Deep and mysterious are the workings of divine providence. I have known men to spend fortunes and practically all their lives in developing bugles that are not in it for a minute with the work of art you have acquired without effort and without price."

I told Bill I had heard all I wanted to hear on the subject and if he had nothing else on his mind, why, the sooner he took wings to himself and flew away, hence the better I should be pleased.

"Why the crabby outlook?," said he. "Here I come over to pay a friendly visit and the best welcome I receive is a bark and almost a bite. Even if your nose is sore, that is no reason why you should be sore all over. If your memory still is in working order you probably will recall that recently I have been interested in methods for mounting patterns. I drifted into a place the other day where a rig has been developed superior to anything of the kind I previously had seen. It is an adaptation of the cast-iron transfer plate but more convenient. Briefly stated, two shallow frames filled with plaster take the place of the transfer plate. It is apparent that if one half of a symmetrical split pattern is mounted on a plate, all the half molds made from that plate will be alike. However, unless the half pattern is mounted definitely in relation to two lines, one drawn longitudinally and the other transversely at right angles to each other and crossing in the center of the plate, it will be impossible to ram the other halves of the molds on the same plate. The advantage of using one plate, of course, lies in the fact that the molder can make copes and drags alternately without losing time over a pattern change. The method also is applicable in mounting patterns for cope and drag on adjoining machines, where conditions warrant such an arrangement.

"A heavy cast-iron plate is provided with reinforcing ribs on the back. The face is machined to a true plane, after which a number of holes are drilled at various points on the perimeter. Some of these holes serve as guides in locating the flasks and others are used for bolting the plate to the molding machine. A longitudinal center line is scribed on the face of the plate and then two pin holes are drilled at each end to locate these holes on either side of the center line. One of the holes at each end is smaller than the other



ALL IN FAVOR OF CAPITAL PUNISHMENT FOR THE CHEERFUL FRIEND PLEASE SIGNIFY THE SAME BY SAYING A

and later, pins provided with shoulders are fastened in these holes by nuts on the lower side. The larger hole at each end is made a loose sliding fit for the cope pins. This is not an arbitrary arrangement, but may be varied to suit the position of the pins on any type of flask. With possibly slight variations, due to pattern design, the following description applies to fitting up any pattern in this manner.

"A wooden master pattern is made, split in the usual manner. Only half patterns are to be cast in metal, but even in cases where both halves of the pattern are symmetrical and interchangeable, it usually is just as easy to make a whole wood pattern split in halves as it is to make a half pattern. Further, in the event that a considerable number of metal patterns are wanted, as for instance, in gates of small valve patterns, two half wood patterns will expedite the job faster than one. The metal half patterns are molded carefully and poured from one ladle to insure uniform contraction also to minimize the necessary amount of finishing. The half patterns are surfaced on the joint side, then matched in pairs and marked by a small prick punch, or, in any other suitable manner so that they may retain their identity throughout all the subsequent operations. Theoretically, all the half patterns are alike, but usually minor points of difference develop and for that reason it is advisable to keep each originally marked pair together. The half patterns are sweated together and finished to the required dimensions. If convenient, all circular sections are finished in the lathe. Two, three, or more small holes are drilled completely through both halves of the patterns to serve as dowel holes. The usual precautions are observed to drill these holes as nearly vertical as possible, in other words, perpendicular to the pattern parting plane.

"The patterns once more are separated into halves and one set of halves placed in any desired position on one side of the center line on the plate. The corresponding halves of the patterns are placed temporarily out of the way. Any number of patterns within the capacity of the flask may be attached in this manner. The distinctive feature of this method now is brought into play. One shallow frame, accurately planed on both sides, is guided into place on the plate by two pins which fit in corresponding holes drilled accurately on the center line of the plate. This frame corresponds in a general, but not necessarily accurate manner, to the length and *half the width* of the flask to be employed on the job in the foundry. Plugs long enough to extend above the top of the frame are inserted in the dowel holes in the patterns and then after patterns and plate are painted with vaseline to prevent sticking, the frame is poured full of plaster of paris.

After the plaster has set, the dowel hole plugs are removed. The patterns now are anchored firmly on the plate and while in that position a drill is employed to continue the dowel holes in the patterns into the plate. In this manner the future position of the patterns on the plate is assured.

"However, at this point they have not served their full purpose. The guide pins are removed and the frame, containing the patterns bedded in plaster, is lifted, turned over and laid upon its back on the work bench. The complementary half of each pattern, recognizable through the identifying marks previously referred to, is located in place by inserting pieces of rod the proper diameter to form a tight fit, through the upper and lower dowel holes in the patterns. The joint and patterns are painted with vaseline and then the second shallow frame is set on the first in the same manner as any ordinary cope. It is filled with plaster and after the plaster has set, the frame containing the plaster and upper halves of the patterns, is lifted off and placed face down on the right hand side of the iron plate. The same pins employed to locate the first frame are employed to locate the second frame. The dowel pin rods are removed and, as in the first instanee, a drill is employed to continue the holes in the patterns, down into the iron plate. The frame then is lifted off for the last time, turned over and laid on its back. The patterns are removed from the plaster in both frames and re-located on the plate by the dowel holes. Tight fitting pins are driven into the holes to attach the patterns to the plate and after the gate and sprue are attached and few minor adjustments made, the plate of patterns is ready to go into the foundry.

"After the frames have served their purpose, the plaster is knocked out and they are ready to be used again upon another pattern or set of patterns. Among the many advantages of this method over the usual transfer methods, perhaps the feature connected with drilling the various holes will appeal to the greater number of men who want to mount patterns in this manner. With the familiar cast-iron transfer plate, the most extreme accuracy in drilling the holes is essential to success. If every hole is not absolutely perpendicular to the parting plane, trouble will be experienced in fitting the second halves of the patterns on the plate, and afterward the cope and drag halves of the mold will not match. With the plaster transfer, a fair degree of accuracy is desirable in drilling the holes, but at the same time a slight deviation will not affect the relative position of the patterns. Instances arise where it may be necessary, or desirable, to arrange four patterns or four groups of patterns on one plate. Two lines are drawn at right angles across the center of the plate. One hole is drilled at the point of intersection and a similar hole drilled on each line at a point corresponding in a general way with the boundary line of the flask to be employed. Instead of using two frames *half* the width of the plate, as in the foregoing example, a pair of frames large enough to cover only *one fourth* of the plate surface, are provided. Details of fitting the patterns, filling the frames with plaster, etc., are the same as already described. Iron transfer plates have been used extensively and while they cannot compare with the plaster method outlined, I should like to touch upon them briefly, if only for the purpose of rounding out this series."

"Hesitate Bill," I said. "Hesitate, in other words,—to borrow from your vocabulary,—lay off that stuff. I am not quite sure that I have assimilated that plaster story. I shall fit up a temporary rig tomorrow and try it out and after I have familiarized myself with the method I shall be pleased to listen further."

"Good work" quoth he, "I am glad to see that you are beginning to show signs of real intelligence. A man may see, read or hear how a thing is done, but the only way to secure a thorough grasp on the subject is to go out and do it with his own little hands. Attaboy, but keep your nose off the grindstone."

Pattern Design Presents Problems-II

(*Concluded from Page* 328)

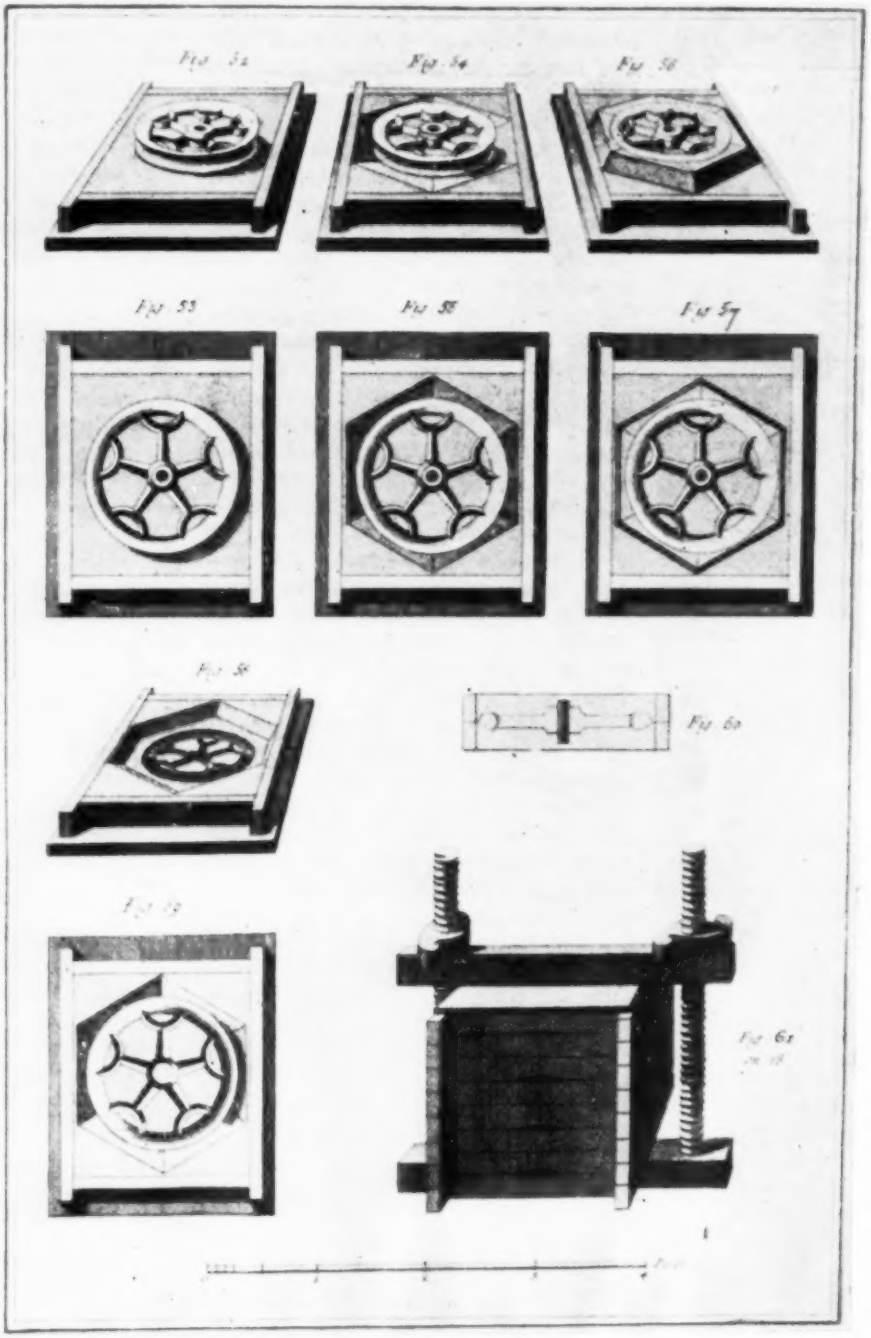
both faces of the flange have to be turned. As the outer face is visible, it is well to mold that in the bottom. If large numbers of castings are wanted, an iron pattern is desirable because one of wood, though strong, is liable to some distortion with long service.

Fig. 25 shows a mine car wheel cast in large numbers. A pattern of wood with rim built up is of little use for permanent service, and the arms are worse, since they cannot be made strongly, or fitted properly in wood. The only way in this case is to make a wooden pattern and cast one from iron with allowance for double shrinkage and to turning on the rim.

Ancient French Foundry Practice

An Old Book Picked Up in a Paris Book Stall Throws Some Interesting Side Lights on the Methods and Appliances Used by Eighteenth Century Craftsmen

INDICATIONS that at least in some respects foundry methods have changed little in the past few hundred years are presented in the accompanying illustration taken from the pages of a book on the subject published in Paris in 1771. The title page bears an inscription to the effect that the book contains a collection of pictures of science, liberal arts, and mechanical arts, with an explanation of them, and further that it was printed at Paris by one Briasson who had a place of business in the Rue St. Jacques. After the date, MDCCLXXI, the concluding line states that the book is published with the approval and privilege of the King. Some pages from this interesting work recently were acquired by H. Glaenzer, Glaenzer & Perreaud, Paris, and through his courtesy, these notes are available. Among the many interesting illustrations is one showing the interior presumably of a typical nonferrous foundry. One workman is shown ramming a mold over a tub, corresponding to the method in vogue in many brass foundries at the present time. A second man is shown working a large bellows which supplies blast for a charcoal fire around a crucible. The only difference in the double pit furnace shown and those in use today is that the pot chambers are square instead of round and charcoal was employed for fuel instead of coke, coal, oil or gas. A third man, referred to in the text as the pourer, is shown pouring the metal. Several molds clamped together are set up on edge over a tub containing a few inches of water in the bottom. The crucible, judged by comparative sizes of other objects in the same illustration, had a capacity of 30 or 40 pounds and was poured directly from the tongs as in present day practice. The water in the tub insured nice clean remelting scrap and the method would appear to present points of superiority over our present method by which all over flow and spilled metal is mixed with the sand on the floor. A number of crucibles reposing on a shelf on the wall above the furnace shows that these ancient foundrymen realized the necessity and propriety of keeping ttheir crucibles warm and dry before placing them in service. A second plate is employed to illustrate the various tools used on the work bench and around the furnace. The dust bag is shown, also the little wooden mallet used for a rammer. These mallets still are used in France and also in the foundries in this country where statuary and ornamental work is cast in French sand. Several plates are devoted to a series of progress views showing the manner in which molds are constructed for various objects. Two methods are shown for molding small sheave wheels, in one the mold is made from a split pattern in a 4-part flask and in the other, shown in the accompanying illustration, one



SUCCESSIVE STEPS IN MAKING A SMALL SHEAVE WHEEL IN A 2-PART FLASK ROLLED OVER TWICE THE MOLDS WERE STACKED AND TURNED UP ON END TO BE POURED

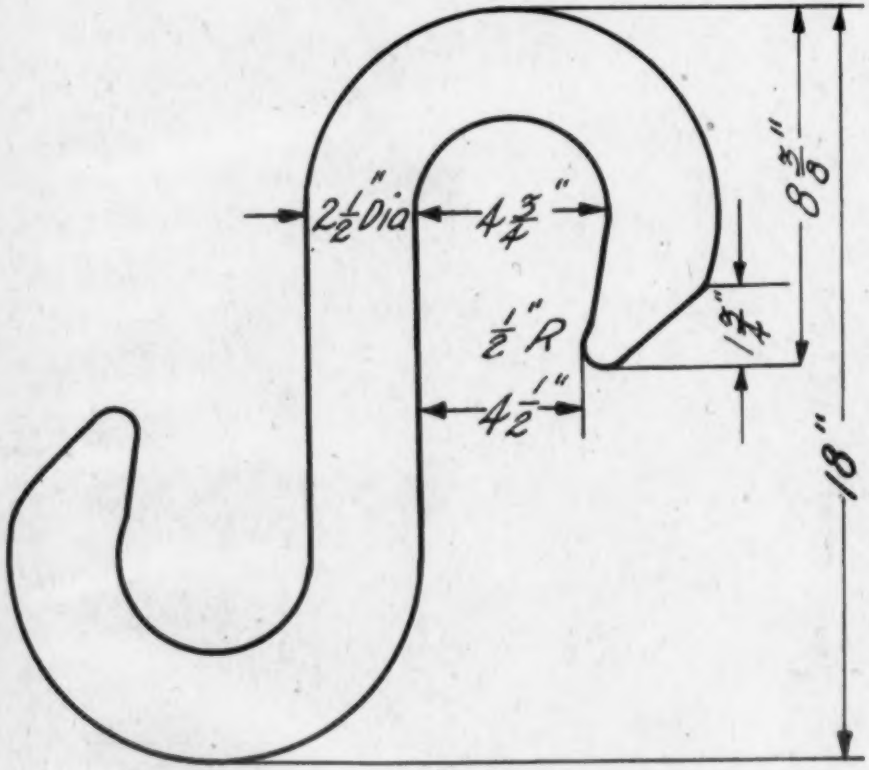
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form

S HOOK FOR FLASK EQUIPMENT

By George W. Childs

Dimensions for a forged-steel *S* hook are shown in the accompanying illustration. *S* hooks are useful in connection with crane hooks, sling chains, etc., used in foundries for handling flask equipment. These hooks should be inspected regularly to prevent hooks which have become badly worn from being used.

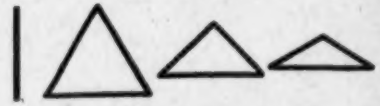


Forged Steel S Hook For Flask Equipment

SAFE LOADS FOR ROPES AND CHAINS

By George W. Childs

NOTE—The safe loads in table are for each single rope or chain. When used double or for other multiples the loads may be increased proportionately.



		When used straight	When used at 60° angle	When used at 45° angle	When used at 30° angle
PLOW STEEL WIRE ROPE—	Dia. inches	Pounds	Pounds	Pounds	Pounds
Six strands of 9 or 37 wires.	5/16	1,500	1,275	1,050	750
If crucible steel rope is used,	1/2	2,400	2,050	1,700	1,200
reduce loads one-fifth.	5/8	4,000	3,400	2,800	2,000
	3/4	6,000	5,100	4,200	3,000
	7/8	8,000	6,800	5,600	4,000
	1	10,000	8,500	7,000	5,000
	1 1/8	13,000	11,000	9,000	6,500
	1 1/4	16,000	13,500	11,000	8,000
	1 3/8	19,000	16,000	13,000	9,500
	1 1/2	22,000	19,000	16,050	11,000
CRANE CHAIN—	Dia. of iron				
Best grade of wrought iron,	1/4	300	....	....	....
handmade, tested, short link	5/16	675	....	....	....
chain, the material having an	1/2	1,200	....	....	....
ultimate strength = 48,000	5/8	1,870	....	....	....
pounds per square inch.	3/4	2,700	....	....	....
	7/8	3,680	....	....	....
	1	4,800	....	....	....
	1 1/8	6,050	....	....	....
	1 1/4	7,500	....	....	....
	1 3/8	9,100	....	....	....
MANILA ROPE—	Dia. inches	Cir. inches			
Best long fiber grade.	5/16	1	120	100	85	60
	3/8	1 1/8	250	210	175	125
	1/2	2	360	300	250	180
	5/8	2 1/4	520	440	360	260
	3/4	2 3/4	620	520	420	300
	1	3	750	625	525	375
	1 1/8	3 1/2	1,000	850	700	500
	1 1/4	3 3/4	1,200	1,025	850	600
	1 1/2	4 1/2	1,600	1,350	1,100	800
	1 3/4	5 1/2	2,100	1,800	1,500	1,050
	2	6	2,800	2,400	2,000	1,400
	2 1/2	7 1/2	4,000	3,400	2,800	2,000
	3	9	6,000	5,100	4,200	3,000

Based on table prepared by National Founders' association.

CAUTION—When handling molten metal, ropes and chains should be 25 per cent stronger than indicated in table.

of the modern methods, involving rolling a 2-part flask twice, is employed. One peculiar feature, noticeable in several of the illustrations is that the flasks are stacked 3 or 4 high, clamped together with a board or plate both top and bottom, and then turned up on end to be poured through openings in the joints of the flasks. Whether this practice was due to a desire to economize in the use of clamps, or whether it was prompted by the feeling that a casting should be arranged in such a manner that it might be poured from the highest point, is open to question. No guide pins are shown on the flasks containing the sheave wheel mold, but that is a draftsman's ommission. They are shown quite clearly in a preceding plate and it may be presumed that the draftsman considered one showing sufficient.

How and Why in Brass Founding

By Charles Vickers

Highly Refractory Sands for Monel Metal

We would like to know the melting point of monel metal; also we desire to learn what is the best sand to use in order to get sound castings of this metal.

The melting point of monel metal is 2480 degrees Fahr. Its specific gravity when cast is 8.87, and when rolled 8.98. The melting point of copper is 1981 degrees Fahr., therefore, the melting point of monel metal is higher than the pouring temperature of copper. That means that sands quite suitable for copper, and hence all alloys of copper, are not suited for monel metal, as their fusing point is too low. The result is they fuse in contact with the heavier bodies of monel metal in the casting. Gases are generated and enter the metal, producing holes, under the scabs. Any good grade of facing, such as is used in steel molding, will be better than brass sand for monel metal. No doubt any steel founder would supply information as to the best facing to use, with special reference to the sands in your vicinity. What is needed is a sand more refractory than the ordinary brass sand. A fine, white silica sand, bonded with fire clay, wet to molding consistency with molasses water, and well milled, makes a better facing than the ordinary steel facing sand. It is also more expensive, but because of the results obtained it is cheapest in the end.

Casting Red Brass for Battery Terminals

We would like to obtain the formula for a red brass alloy that can be used for making small castings for battery terminals. These castings are dipped in a lead solution, and must have a smooth surface. We use a No. 1 Albany sand.

It would be advisable to face the molds with a finer grade of sand than No. 1, as the latter is too coarse for fine work. Any foundry supply house will furnish a fine brass sand, which can be used to form the entire pile, but if the usual run of castings requires a No. 1 grade, the fine sand should be mixed to the proper dampness and be used simply as a facing on the patterns. The following alloy makes a nice red brass; one that will color well and is tough, and at the same time easy to machine. The alloy follows:

RED BRASS ALLOY

	Per cent
Copper	87.50
Zinc	6.50
Tin	3.50
Lead	2.50

Aluminum in Brass Held to a Minimum

We are experiencing considerable trouble in running brass ferrules. These castings are molded two in a flask from split patterns, as owing to an increase in diameter at one end and a flange at the other, they have to be molded horizontally. The gate is oval, half in cope and half in drag, and is simply a straight stick connecting the two castings, with a dish hollowed out at the bottom of the sprue, the latter being midway between the castings. The difficulty is due to small holes and dross in the castings around the gates. The metal consists of rolled yellow scrap, high in zinc, and we have to add about 1 per cent of aluminum to get it to run. Dry-sand cores are used, and the metal is melted in plumbago crucibles in coke-fired furnaces. It is skimmed clean before pouring. At present we are using no flux, but contemplate trying one of the advertised brands. We are sending samples for your information.

The less aluminum that is used the greater will be the chances of getting clean castings. Two ounces of aluminum should be sufficient instead of 1 per cent. At the most there is no reason why 0.25 per cent aluminum should not do the work. No flux that can be used will have the least effect on the dross. It is formed as the metal enters the mold and is caused by the aluminum. It is a case for the exercise of ingenuity in gating, as the present gate will never run clean castings. The metal enters with a jet effect, like water from a hose nozzle, and impinges onto the core; the ideal method of making dross with this alloy. If the molder once grasps the idea as to the cause of the dross, he will know how to gate and avoid the same. He must bear in mind at all times that aluminum is a metallic soap. It has the same property in metal as soap does in water; viz.: the property of lathering. The lather is dirt and dross which makes holes and drossy metal. If the molder can devise a gate that will *ease* the metal into the mold without lathering or foaming he will have solved the problem of how to make clean castings. An analysis of the alloy will save money, as there is a possibility of adding considerable more zinc.

Casting Sprinkler Heads

We are thinking of casting automatic sprinkler heads, using the following alloy which we will buy in ingot form. The alloy is copper, 88.50 per cent; tin 9.25 per cent; zinc, 1.50 per cent; lead, 0.75 per cent, and phosphorus, 0.125 per cent. We would like to know at what temperature the metal should be poured, whether the ingot should be melted under charcoal, and if any flux is necessary. We will melt with coke-fired artificial-draft furnaces, and expect to use a pyrometer. The metal must pass the underwriter's inspection.

The use of ingot metal for these castings is to be commended. It is better to use ingot metal of known composition than to attempt to make the alloy from new metals. Also, it will be considerably

cheaper. Simply place the ingots in the crucible in such a manner they will not crack the pot as they expand when heated. That means they must not be wedged in the pot. It would be advisable to use a deepener on top of the crucible, to be able to charge in all the ingot at one time. The deepener can be made by cutting the bottom off an old pot. Simply set it on top of the coked-up crucible and put no coke around the deepener. Fill with ingots, put in some hard wood or charcoal, and melt. It is not necessary to use any flux, simply charcoal. The only criticism that could be directed at this alloy is that it is too high in phosphorus. The maximum amount of phosphorus for this alloy is around 0.015 per cent. The pouring temperature should come within the range 1100 to 1140 degrees Cent. (2012 to 2084 degrees Fahr.).

Extremely Hard Copper not Obtainable

We desire to cast a hard copper, as hard as steel, if possible. It must test 70 degrees hardness or better, and not be brittle. Can you give us a formula for such an alloy?

There is only one way in which copper can be hardened to brinell number 70 and better, which no doubt is meant instead of 70 degrees, as there is no such hardness scale. The way to harden copper to around 90 brinell is to cast it of soft, high conductivity copper, a little oversize, then forge it down. This forged copper will be hard, tough and pure, but it will never compare with steel. Another method of hardening copper is to melt it under charcoal, then deposit on the surface 2 per cent of yellow prussiate of potash, and allow it to boil out the water after which it is stirred into the copper. Next cast this treated copper and forge the castings, and they will be hard. Such things as copper daggers have been made in this manner. The addition of phosphorus will also harden copper, but it robs it of its red color However, the only reliable hardeners of copper are tin and aluminum, either one, or both together, but the result is an alloy of copper, and not copper. In the present case use an alloy of 16 per cent tin and 84 per cent copper.

Commutator Bars Cast within Close Limits

We would like to learn the best way to mold copper commutator bars, in order not to get gas or blow holes in the top. What sand should be used? At what temperature should the copper be melted and poured? Which are the better: snap or steel flasks? Our furnace is an oil-fired crucible furnace using air pressure at 16 ounces. Will a pyrometer be necessary, or can the proper melting heat be judged by the eye?

Copper commutator bars have to be cast (when so made) accurate to size within very close limits. This accuracy demands extreme accuracy in pattern equipment. Loose wooden patterns are out of the question for large orders, and when used for odd commutators they must be molded by especially skilled artisans. This demand for accuracy makes necessary the most perfect foundry equipment that can be obtained. The patterns must be plated. The flasks should be interchangeable, and fit perfectly. Aluminum top and bottom plates are helpful. Pour the molds flat with a sprue at one end of the gate and a riser at the other to equalize the pressure and prevent straining of some of the bars in the mold. Use a fine grade of brass sand. Bottom-pour crucibles are best for copper because they eliminate the necessity for skimming. The deoxidizer largely will depend on the equipment of the shop. If the cast bars can be stamped or rolled to exact size, the bar is stiffened and a soft, high-conductivity copper can be used. If no mechanical work is done on the bars, it may be necessary to use phosphorus as a deoxidizer and stiffener. If the copper is melted under charcoal, deoxidized, stirred with a carban rod, and poured when sufficiently fluid to properly run the castings there will be no trouble.

Casting Brass Dies

We desire to get a bronze mixture suitable for casting dies which will come out of the sand smooth. These dies weigh from 60 to 80 pounds and are used for printing celluloid novelties. We have been using an alloy of copper 72 pounds; tin 6 pounds; zinc 4 pounds; phosphor-tin 0.25 pound; aluminum, 0.25 pound.

To get the smooth surface required on the die, it is necessary to add aluminum to the alloy, but there is no advantage in using phosphorus with the aluminum. The alloy used for dies is a copper-alloy containing a little aluminum, and the following mixture is suitable.

COPPER-TIN DIE ALLOY

Copper	84 pounds 14 ounces
Tin	15 pounds
Aluminum ...	2 ounces

Melt the copper carefully under charcoal and add the aluminum, stir and add the tin. The molds should be faced with a fine sand, then be printed back and skin dried.

Run the metal into the molds without agitation. Otherwise, dross will form and spoil the face of the impression. To print back, lift the scroll work in the cope, lay back the cope and spray with a fine spray of molasses water, then dust fine sand such as Windsor Locks, or beam dust, through a bag onto the damp impression, and on top of the dusted sand, dust lycopodium. Then reclose the cope and reram with the butt rammer, and lift off again. The impression should be perfect, and the castings so smooth, little chasing is required.

Removing Iron from Brass

In remelting scrap copper, brass and auto radiators, we are troubled with too large a percentage of iron, which runs as high as 1 or 2 per cent. Can you suggest a flux for us to use that will eliminate the iron? In remelting yellow brass borings and scrap we sometimes find aluminum present, not merely a few tenths, but sufficient to be objectionable for many castings. We would like to learn of some method for eliminating this during the melting process.

Plaster-of-paris is stated by some authorities to be effective in removing iron from yellow brass. It should be used freely, some being mixed with the cold metal, and more added after the melt is made. All visible iron should be removed before the material is melted, and turnings should be put through a magnetic machine several times if necessary. We have little faith in the value of fluxes for removing iron from alloyed metals in ordinary melting operations. Iron is removed from copper in the proper furnace. Aluminum is another troublesome metal to remove from brass. If copper oxide is used for the purpose, the zinc will be removed with the aluminum, and the latter will be present as long as the zinc lasts.

Benedict Nickel Formed

We would like to obtain the analysis of Benedict nickel.

Benedict nickel is an alloy of copper and nickel used for condenser tubing and other purposes. It usually is used in the form of rolled sheet or drawn tubing, and not for casting purposes. The composition of Benedict nickel may vary a little, the copper content ranging from 84 to 86 per cent, and the nickel from 14 to 16 per cent. An alloy of copper 80 per cent; nickel 20 per cent is also known by the name of Benedict nickel. When used for castings, the alloy should be deoxidized by the addition of magnesium copper, adding 0.5 per cent of the 10 per cent alloy.

Correcting Flaws in Metals and Mixes

Problems of the Gray-Iron, Malleable and Steel Foundry Discussed
By H. E. Diller

Pointers on Cupola Malleable Iron

Question—We would like to know some general details about the manufacture, composition and properties of cupola malleable iron.

Answer—In a general way we can say that cupola malleable is melted similarly to gray iron from a mixture of pig iron and hard-iron sprues and scrap. Sometimes a few per cent of steel or malleable scrap is used. A somewhat higher percentage of coke is used in melting malleable iron, because of its lower silicon content and the higher temperature required to pour it. Care must be taken so that too much sulphur is not taken up from the coke. The amount of sulphur in the iron is kept below 0.10 per cent. Silicon is generally held between 0.7 and 1.0 per cent; phosphorus between 0.16 and 0.20 per cent; manganese between 0.20 and 0.30 per cent and total carbon will amount to a little more than 3.25 per cent in the hard iron. The strength of cupola malleable will range from 35,000 to 45,000 pounds per square inch. The elongation will be lower than the elongation secured from the average air furnace malleable, indicating that it is not as flexible or malleable.

Pickling Stove Plate

Question—What is the method of pickling stoveplate castings preparatory to polishing them for nickel plating?

Answer—The best method would be to pickle them in a solution of hydrochloric acid, commercially known as muriatic acid, using 1 part of acid to 10 of water. It is necessary to allow the casting to remain in the acid until all the sand is removed then take it out and dip it into boiling hot water. A second bath of hot water is a good plan, as the first bath soon becomes contaminated with the acid.

Pickling is generally giving place to sandblasting stoveplate castings. Then after being polished the castings are dipped into a boiling solution of caustic. Sometimes caustic potash and sometimes caustic soda is used. This solution is made by mixing one part of caustic in eight parts of water. The castings are merely dipped into the solution to clean off the grease and are then given a dip in a solution of 1 part sulphur acid to 20 parts water, which is at room temperature. From this dip they are put into a bath of cold, clear water through which a stream is running constantly.

Metal Loss in Electric Melting Furnace

Question—Would there be any loss in melting cast-iron borings in an electric furnace, and if so what would this amount to?

Answer—Undoubtedly a small loss would be sustained in melting cast iron borings in the electric furnace. This loss would be due to oxidation of carbon, and of silicon, manganese and iron which would go into the slag. The percentage of loss would be entirely dependent upon melting conditions and may amount to from 2 to 5 per cent of the amount of borings charged.

Suitable Metal for Side Blow Converter

Question—We should like to know the kind of a charge and the composition of the metal found by American practice to give the best results in a side-blow steel converter, in which the metal is melted in the converting vessel by oil fuel.

Answers—As far as we know, there are no such converters used in America, but all metal for side-blow converters is melted in cupolas. The cupola charge consists of 30 to 50 per cent steel scrap and the remainder pig iron. The metal as it comes from the cupola contains 1.50 per cent silicon and and 0.50 per cent manganese. The phosphorus and sulphur are kept as low as possible but sometimes will go as high as 0.07 per cent. Total carbon will average approximately 3.2 per cent.

Steel Castings Will Rust

Question—We should like to know what precautions usually are taken to prevent steel castings from rusting.

Answer—Steel castings in storage are prevented from rusting by covering them with a mixture of rosin dissolved in hot vaseline. The paste may be made thick or thin by regulating the amount of rosin. A zinc coating frequently is used to permanently retard rusting of steel castings. This coating may be applied either by galvanizing in a bath of molten zinc or by sherardizing. The latter process which is patented consists in tumbling the castings in heated powdered zinc. Another method of rust prevention is the Bower-Barff process in which the castings are heated in a steam bath. A detailed description of this process was published on page 105, THE FOUNDRY in the issue of Feb. 1, 1920.

Making Lathe Chucks

Question—Please advise us the best mixture for making lathe chucks. We are making them with a cover core and have trouble with dirt in the bottom of the slots.

Answer—Lathe chucks should be made of an iron containing approximately 2 per cent silicon, less than 0.12 per cent sulphur and anywhere from 0.3 to 0.7 per cent phosphorus and 0.5 to 0.9 per cent manganese. Thirty to sixty per cent gray-iron scrap should be used in the mixture and as high as 15 per cent steel scrap may be used, the remainder being pig iron. From the meager information you give in your letter we should judge that your trouble is mainly due to molding. We would recommend that you mold the chuck with the groove in the drag and that you pay particular attention to have your cores well blackened.

Hard Cores Responsible for Piston Cracks

Question—We make automobile engine pistons, using a dry-sand core and have trouble with them cracking. Would iron containing 0.7 to 0.8 per cent phosphorus cause this?

Answer—You do not give as much detail in regard to the job as we would like to have but from what you say, we judge that the main trouble is that the cores are too hard and do not break up easily enough when the casting cools and contracts, thus causing a strain which cracks the piston. The amount of phosphorus which you have in your iron, that is, 0.7 to 0.8 per

cent, would tend slightly to cause the castings to crack but it is not the main cause as piston castings can easily be made from iron having this amount of phosphorus without cracking. You would, however, secure a casting which would be less apt to be porous by using a lower phosphorus iron. Many foundries use malleable bessemer pig iron for automobile castings. If you are not able to remedy your trouble by using a more friable core, please advise us at what point they crack, the method of gating and the complete analysis of your iron.

Alternative Patternmaking Methods

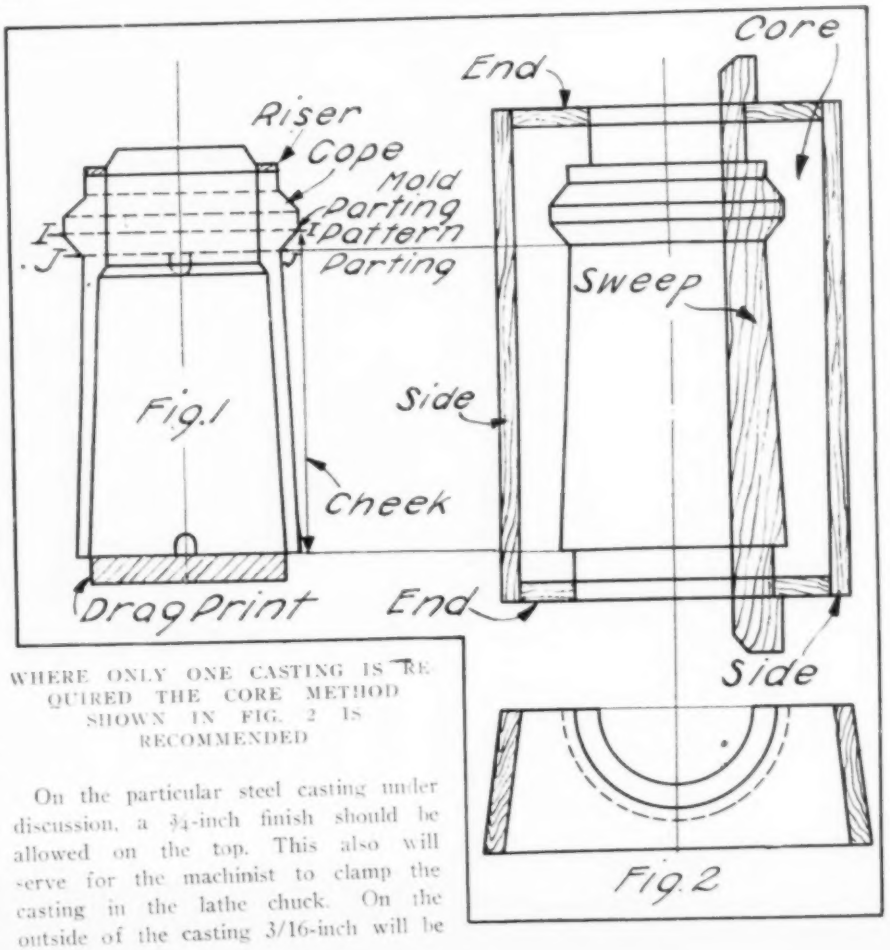
IN THE March 1 issue of THE FOUNDRY, M. E. Duggan describes how a pattern was made by a patternmaker not familiar with foundry practice. He also states that the foundryman changed the construction and adapted it to his requirements. He deplores the fact that as a rule patternmakers know little of the methods employed in the foundry and concludes with a request that patternmaker readers should indicate how they would have handled the job. In reply J. V. Rehor submits the following:

Nine out of ten patternmakers would not stop to consider how the pattern described by M. E. Duggan in the March 1 issue of THE FOUNDRY should be made. They probably would proceed as he did and make a split pattern to be molded on its side. However, there is no excuse for the 2-inch prints on the ends. Even a tyro should know that such prints are not capable of supporting a 12-inch core nearly 3 feet long. The proper way to secure solid castings is to mold and pour them on end and the two following methods are submitted as improvements over that presented by Mr. Duggan. The first method would be adopted where several castings are required and the second method would prove economical in the event that only one casting was ordered.

The pattern is made in three pieces as shown in Fig. 1; the lower print *A*, the body *B* and the top part *C*. It will be noted that the parting line on the mold between cope and cheek does not coincide with the upper parting line on the pattern. It is apparent that if the pattern was parted on the line *II*, it would be necessary to provide a second joint on the line *JJ*. Otherwise it would be impossible to draw the pattern out of the cheek. By parting the pattern on one line and the mold on another line, this feature is eliminated, and the job may be molded in an ordinary 3-part flask. For the benefit of any reader who may not have read the former article it may be stated that the body of the pattern *B* is *back-drafted* and therefore instead of drawing the pattern *up* out of the cheek, it is necessary to lift the cheek off the pattern.

The lower print is made loose so that the drag may be rolled over. This arrangement is not arbitrary and if the foundryman prefers to bed the print in the drag, the print may be nailed solidly to the pattern. A parting is made at the lower edge of the pattern and then the cheek flask is rammed full of sand up to the line *II* on the pattern shown in Fig. 1. A second parting is made at this point, the cope flask is set on, rammed full of sand, lifted off and finished. The upper part of the pattern *C* is removed and then the cheek is lifted and set to one side. The pattern *B* either may be held down while the cheek is taken off, or it may be pushed down through the cheek after the latter has been set on suitable stands. The mold is finished, dried, cored and reassembled in the usual manner.

The second method recommended, where only one casting is wanted, is shown in Fig. 2. The only pattern equipment required is an open frame and a strike to form the two outside halves of the mold. The center core may be made either in a half box or a skeleton frame. Any handy man can cut out two end boards, then cut out a half circle in each end to conform to the size respectively of the drag and cope core prints. Side pieces are nailed to the ends, then the frame is placed on a core plate, filled with sand and cut out with the sweep, until the interior of the half core corresponds to the shape of the casting. Two half cores are made and dried. They then are set up on end with the center core between them and after they have been



WHERE ONLY ONE CASTING IS REQUIRED THE CORE METHOD SHOWN IN FIG. 2 IS RECOMMENDED

On the particular steel casting under discussion, a ¾-inch finish should be allowed on the top. This also will serve for the machinist to clamp the casting in the lathe chuck. On the outside of the casting 3/16-inch will be ample for rough finish, while a little more might be allowed on the inside.

surrounded by a flask filled with rammed sand, the mold is ready to pour.

Henry Sale would simplify the job still further by making the exterior ring in sections so that it might be drawn into the mold after the pattern had been drawn out of the drag. He would mold the pattern in the opposite position to that shown in Fig. 1, that is with the small core print on the bottom and in this manner would only require a 2-part flask.

Eastern Shops Will Make Tunnel Segments

One of the largest single foundry jobs ever placed was awarded recently when Booth & Flynn, Ltd., New York and Pittsburgh, formally let approximately 115,000 tons of cast iron and steel segmens to the Bethlehem Steel Co., Bethlehem, Pa., and Davies & Thomas, Catasauqua, Pa., for the proposed New York-New Jersey vehicular tunnel. Of this total, the Bethlehem Steel Co. was awarded approximately 58,000 tons of cast iron segments, and all of the steel segments, comprising 9500 tons, while Davies & Thomas were awarded the remainder of the cast iron segments, approximating 48,000 tons.

In addition, the Bethlehem company will furnish 11,000 tons of shapes and plates for shields, caissons, tunnel flooring, and auxiliary buildings, and will also furnish a considerable amount of the required 1,000,000 nickel steel bolts, 1,000,000 nickel steel nuts, and 2,000,000 nickel steel washers. From 800 to 900 tons of pipe, including approximately 300 tons of cast iron pipe, 547 tons of bars, and a considerable tonnage of sheets will also be required.

The pig iron requirements for the segments will run over 105,000 tons, as it is believed little scrap will be required. As a producer, it is believed the Bethlehem company can furnish pig iron at a price equivalent to, if not cheaper, than the heavier grades which would constitute the bulk of the scrap otherwise required. Davies & Thomas, also will confine their requirements principally to pig iron. In any event, it is not likely that they will require more than 10,000 tons of scrap.

While both companies are unusually well equipped for handling work of this character, a fairly substantial amount of equipment will be purchased, especially foundry apparatus. Davies & Thomas is purchasing considerable sand blast equipment, including a sand blast room, blowers, dust collectors and ventilating and conveying apparatus. Sand sifting and tempering apparatus also will be required, and a plain jolt machine and a 10-foot jolt rollover machine, orders for which have just been placed with the Osborn Mfg. Co., Cleveland. Three overhead cranes, ranging around 7½ to 10 tons capacity, and two jib cranes of at least five tons capacity, will be closed shortly. In addition, the company contemplates the purchase of an electric furnace.

The requirements of the Bethlehem Steel Co., while possibly comprising somewhat different items, will run as large, if not larger, it is believed, and may include more tools, although it is thought the company is well equipped with boring mills, one of the particular items required for this kind of work.

Booth & Flynn, the general contractors, whose bid incidentally, was $19,331,723.50, will erect a small repair shop, but will equip it for the most part with machinery brought from its shop in Flushing, L. I. Some locomotive cranes will be required, but these probably will be bought second hand.

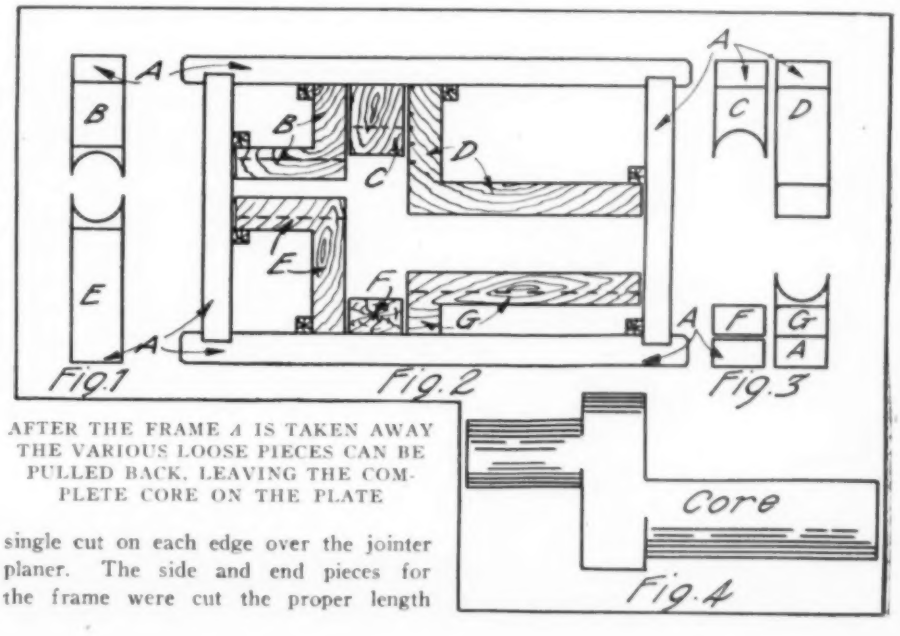
Skeleton Corebox Forms Core in One Piece

By M. E. Duggan

Fig. 2 is a plan view of the core box, Figs. 1 and 3 are end views of the detail pieces, Fig. 4 is the core made in this box. In making this box a working board was dressed a little wider and a little longer than the required frame *A*. This board was perfectly flat and *out of wind*. A full size drawing of the core outline was made on the board. Four pieces of common lumber were selected for the frame and a sufficient number of pieces of stock to form the box were taken from the pattern lumber pile. The lumber for both box and frame was ripped at one setting of the rip saw with allowance for a single cut on each edge over the jointer planer. The side and end pieces for the frame were cut the proper length to embrace the core. In the illustration the ends are shown checked into the sides, but this construction is not necessary. After the frame is nailed together, a block glued in each corner will furnish all the reinforcement required.

The pieces *B B*¹, *C*, *D D*¹, *E E*¹ *F* and *G G*¹ were cut and trimmed from the long stock previously ripped on the saw. The half circles in the pieces *B*, *E*, *C* and *G* were cut out on the band saw. In this connection and particularly for the benefit of young patternmakers who are not yet hampered by tradition, I want to point out that the full possibilities of the band saw rarely are utilized in the pattern shop. Circles like those shown in the illustration can be cut right to the line provided a narrow saw blade is employed.

The two pieces *B* and *B*¹ were nailed and glued together and the same procedure was adopted with *D* and *D*¹ *E* and *E*¹ and *G* and *G*¹. The frame *A* was placed on the board and fastened in place temporarily with a few brads. The right angle pieces *B*, *D*, *E* and *G* were assembled on the inside according to the outline scribed on the board. The loose pieces *C* and *F* also were set in place. Small blocks as shown in the illustration were glued on the inside of the frame to prevent the loose pieces from spreading and also to serve as a guide in locating them in their proper relative positions. Letter punch marks on top of the loose pieces and at corresponding points on the frame furnished additional assurance that the box would be assembled properly in the foundry. The coremaker assembled the frame and box on a core plate, placed his rods, filled the box with sand.



AFTER THE FRAME *A* IS TAKEN AWAY THE VARIOUS LOOSE PIECES CAN BE PULLED BACK, LEAVING THE COMPLETE CORE ON THE PLATE

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Research Work as an Educator

MANY factors are responsible for the growth and commercial success of any manufacturing organization, but even a superficial survey of the industrial field will indicate to any interested observer that adaptation to changing conditions and the adoption of new and improved methods and processes characterize all firms which have been in business over a long period of time. This phase of business life sometimes means that additions are built to the factory and new methods and machinery installed to catch up with a created demand, but more frequently it means that the demand has been anticipated and the factory is producing goods, and selling them, before the public fairly realizes that it actually needs them. This plank is so well recognized in the economic and industrial platform, that many large manufacturing enterprises set aside appropriations for the maintenance of research staffs which conduct experiments within reasonable limits on all phases of the company's manufacturing activities.

Investigations are pursued along widely diversified lines and range all the way from strictly utilitarian and practical experiments designed to reduce the time consumed, the amount of material employed, the total manufacturing cost, or all three, on some specific article, up to abstruse problems in the rarefied atmosphere of pure science.

Armed with microscope and camera, with trained minds, with love for their work and with a capacity for taking infinite pains in the solution of any problem to which they may be assigned, these modern pioneers have gone into the foundry jungle and routed many of the terrors before which foundrymen have grovelled for ages. They have stripped them, taken them apart, blown away the clouds of mystery in which they have been enveloped and in many cases, showed on what a pitifully childish foundation many of these old foundry myths and superstitions have rested.

Once a problem has been solved the result is turned over to the executive staff for practical application, leaving the investigator free to devote all his attention to the following puzzler on his list, or to one that unexpectedly makes its appearance. The beneficial results arising from work of this character is not confined entirely to the plants with which these men are connected. Usually it is disseminated freely by personal contact, in the form of papers read before technical associations and through the columns of the technical press.

Men naturally follow the line of least resistance and resist changes and innovations even when such change promises amelioration of existing conditions. Information of a helpful or constructive character filters slowly through an industry, especially if its application involves the scrapping of old and the installation of new equipment. To the average man a dollar in hand today overshadows the prospect of a possible two or three dollars tomorrow. Defective castings have been produced in the foundry, and probably will be produced, so long as the human element is a contributing factor; but defective castings due to ignorance of materials and methods on the part of those in charge of operations, gradually are disappearing from the foundry.

Trade Outlook in the Foundry Industry

APRIL shows every indication of proving a record month in practically every branch of industry, if the first week may be accepted as a true measure of promise. The steady improvement marked some weeks ago has continued with uninterrupted acceleration, though in no single line is there evidence of ill-advised activity or tendencies toward over optimism in appraising opportunities. The demand for goods has been emphasized by the long period of subnormal production and the continued dearth of buying.

Rail Factor Important

Perhaps the leading factor in the buying movement at hand is the delayed railway purchases which now are coming forward strongly. During the past week, the New York Central lines have placed orders for 19,000 freight cars. Further, two western roads in the same period have ordered 5000 cars, while the Pennsylvania system has announced the expenditure of $8,000,000 on improvements in the Pittsburgh district, constituting a portion of a $100,000,000 program. The railway car orders placed during the first week of April constituted the largest total in four years. Further, about 25,000 additional cars now are being negotiated and probably will be placed in the near future. That this buying movement is not undertaken a day too soon is evidenced by the steadily dropping total of surplus car weekly averages, and by the increased transportation demands incident to more general commercial activity. Traffic experts agree that even with the most favorable deliveries on recent rolling stock orders, railway facilities soon will be found inadequate. Castings demand, incident to these railway orders, is increasing steadily, nor is this activity confined to any one section as previously has been the case. Car repair business, also is providing an active castings demand.

Prices of Raw Material for Foundry Use

CORRECTED TO APRIL 6

Iron		Scrap	
No. 2 Foundry, Valley	$19.00 to 19.50	Heavy melting steel, valley	$16.00 to 16.25
No. 2 Southern, Birmingham	16.00	Heavy melting steel, Pitts.	16.00 to 16.50
No. 2 Foundry, Chicago	20.00	Heavy melting steel, Chicago	13.00 to 13.50
No. 2 Foundry, Philadelphia	20.84 to 21.26	Stove plate, Chicago	14.50 to 15.00
No. 2 Foundry, Buffalo	18.50	No. 1 cast, Chicago	15.25 to 15.75
Basic, Valley	18.00 to 18.50	No. 1 cast, Philadelphia	17.25 to 17.50
Basic, Buffalo	18.50	No. 1 cast, Birmingham	13.00 to 14.00
Malleable, Chicago	20.00	No. 1 cast, Buffalo	16.50 to 17.00
Malleable, Buffalo	18.50	Car wheels, iron, Pittsburgh	16.00 to 16.50
Coke		Car wheels, iron, Chicago	17.00 to 17.50
Connellsville foundry, coke	$4.00 to 4.50	Railroad malleable, Chicago	15.00 to 15.25
Wise county foundry, coke	5.50 to 5.75	Agricultural mal., Chicago	15.00 to 15.25
		Railroad malleable, Buffalo	13.00 to 14.00

Auto Plants Active

Of the other main contributing fields, probably the automobile factories are providing the most important factor in a strengthening market. During the past two weeks, larger orders for castings have been placed than have been noted in more than a year. Predictions are made that with the maintenance of the present rate, the four months ending June 1, will mark a new high record in automobile production. Prices for gray iron castings used in the engines of both passenger cars and trucks are exceedingly low. One contract for cylinders recently was placed in northern Ohio at a price which will net less than 2.75c a pound. With the improvement in automobile production is noted an encouraging advance in the manufacture of tires, bringing a pickup in demand for tire mold and rubber machinery castings. March showed a total output of 1,163,000 tires, while this will be exceeded by several hundred thousand in the Akron district alone in April. Some of the larger production foundries in the territories contributing to the automobile and tire industries now are operating at capacity.

Indications Bright

Building construction still is advancing, and the recurrent demand for castings is strong. Sanitary ware and plumbing goods foundries in particular are active, while stove and furnace shops continue to work practically at capacity. That this activity is more than merely sectional, is shown by reports from the South and throughout the West. One Minneapolis stove foundry reports that during the first three months it has shipped more ranges than in any previous quarter of its 31 years existence. The steel industry, again is an important customer for castings. With mills in the Mahoning valley operating at a better rate than at any time in the past two years, the roll demand is heavy. Roll foundries in the Pittsburgh district have increased their rate of operation from 25 per cent to 50 per cent. The price of rolls, which is fixed by agreement at 3.60c until June is held to be too low and an advance is expected at that time. Pig iron production for March, according to statistics in *The Iron Trade Review*, was the greatest since January, 1921. The output of all classes of iron totaled 2,034,784 gross tons, showing an increase of 404,604 tons over the preceding months total of 1,630,180 tons. The total output of merchant iron during March was 390,643 tons, a gain of 35,188 tons over the February figure of 355,455 tons. On a daily production basis, this was an average loss of 93 tons per day, the February daily average showing 12,694 and the March average 12,601 tons. However, a most encouraging feature is noted in the total of furnaces in blast. On the last day of March, 155 blast furnaces were operating, compared with 139 on Feb. 28.

Brass Shops Busy

Automobile and plumbing goods brass foundries are increasingly active, while the demand for aluminum castings, particularly from manufacturers of household appliances is improving. Nonferrous prices, based on New York quotations in the *Daily Metal Trade* of April 6, follow: Casting copper, 12.37½c to 12.50c; electrolytic copper, 12.75c to 12.87½c; Straits tin, 29.62½c; antimony, 4.50c; lead, 4.90c to 4.95c; aluminum, No. 12 alloy, producers' price, 19.00c to 19.20c, and open market, 15.00c. Zinc is 4.85c to 4.90c, E. St. Louis. Monthly average prices on nonferrous metals for March follow:

(New York Quotations)

Casting Copper	Electro Copper	Lead	Tin Straits	Antimony	Aluminum 98-99	Zinc St. Louis
12.575	12.909	4.726	29.173	4.24	17.559	4.654

Personal

Robert Walker has been made superintendent of B. & M. Foundry, Springfield, Ill. Mr. Walker formerly was superintendent of foundries for the American Marine Iron Works, Portland, Oreg., a position which he resigned after three years' service to take up his connection with the Springfield foundry. His experience covering the past 20 years has included acting as foreman or superintendent for foundries of the Llewellyn Iron Works, Los Angeles, Cal., McEwen Mfg. Co., Tulsa, Okla., Utah Copper Works, Garfield, Utah, and the Fuller Iron Works, Providence R. I.

E. T. Pelton, vice president of the Armstrong Steel Castings Co., Huntington, Ind., resigned effective April 1.

J. O'Donnell, formerly foundry superintendent, Nichols & Shepard Co., Battle Creek, Mich., has been appointed foundry superintendent of the American Steam Pump Co., of that city.

Earle J. Byerlein, who has represented Osborn Mfg. Co., Cleveland, O., on molding machine sales, with headquarters in Milwaukee, Wis., has resigned to enter into business for himself.

Floyd W. Moyers, for the past two years superintendent of the foundry of J. B. Prescott & Son, Webster, Mass., has taken over the grinding plant of the firm and will operate it under the name of the Webster Grinding Co.

A. P. Deeley has been appointed foundry superintendent, Nichols & Shepard Co., Battle Creek, Mich., threshing machine and separator manufacturers. Mr. Deeley formerly was with the Clover Foundry Co., Muskegon, Mich.

J. K. Williams, founder and former president of the Williams Foundry Co., Akron, O. will re-enter the foundry business this month as vice president of the Franz Foundry & Machine Co., at Barberton, O., of which C. Franz is president.

C. J. Houck has been made foundry superintendent for the Hess-Snyder Co., Massillon, O. Mr. Houck formerly was connected with the malleable plant of the Timken-Detroit Axle Co., Canton, O. and previous to that time was with the Vulcan Iron Works, Denver, Col.

Harry Fowler has been appointed sales manager in charge of the Cincinnati territory for the Carborundum Co., Niagara Falls, N. Y. Mr. Fowler succeeds Charles R. Cox who on July 1 will be transferred to the main office of the company where he will be engaged in work connected with sales statistics.

C. L. McMasters has been appointed sales manager for the Holmes Bronze Foundry Bedford, O. Mr. McMasters formerly was sales manager for the Cleveland Brass & Copper Mill, Cleveland, and previous to that time he was connected with the Pratt & Lambert Varnish Co., having had charge of their railway sales department. Mr. McMasters was graduated from Ohio State university, Columbus, O. in 1905.

Howard Greene, who for a number of years has been associated with the Bridgeport Malleable Iron Works, later Chain Belt Co., Milwaukee, Wis., and until recently assistant superintendent to Wilmot T. Hercher at the Great Lakes Malleable Co., Milwaukee, Wis., has been appointed superintendent of the malleable foundry, Walker Mfg. Co., Racine, Wis., manufacturer of automobile jacks.

William B. Neal, for some time manager of the Chicago sales district of the National Cast Iron Pipe Co., with offices in the Peoples Gas building, has resigned to become manager of sales of the Chattanooga division of the Somerville Iron Works, Somerville, N. J., effective April 1. He will maintain his office in Chicago. Mr. Neal is succeeded by A. E. Nelson for some time in charge of the Kansas City office of the National Cast Iron Pipe Co.

Robert C. Stanley, who recently has been made president of the International Nickel Co., has directed a reorganization to include a new department of development and research with headquarters at 67 Wall street, New York. This department will be under the direction of A. J. Wadhams as manager and with him will be associated Dr. Paul D. Merica, director of research. The new department will study the products of the company and assist in their successful use by the consumer.

Will Install Machinery for Segment Castings

For molding the tunnel segments for the New York-New Jersey vehicular tunnel, the Bethlehem Steel Co., South Bethlehem, Pa., and the Davies & Thomas Co., Catasauqua, Pa., will install complete molding machine units built by the Osborn Mfg. Co., Cleveland. These special outfits to be installed by each company, consist of two large size, heavy-duty, roll-over, jolt-ramming machines of 15,000 pounds capacity each for making drag molds; two plain jar-ramming machines of 12,000 pounds capacity each for making the cope molds; two roll-over, jolt-ramming machines of 1200 pounds capacity each for producing the end cores and four motor-driven machines for filling the flasks with sand. In addition to the foregoing the Bethlehem Steel Co. will install three hand-operated machines for making the side cores. The Davies & Thomas Co. already has the latter equipment.

The Bethlehem Steel Co. will furnish 58,000 tons of these segments and the Davies & Thomas Co. 48,000 tons. The ring segments weigh approximately 3200 pounds each. On their outer circumference these are 77.672 inches long, while the key segments are 11.868 inches long. For the two tubes 82,264 ring segments of the large size will be required and 5,876 narrow key segments. Each ring is made up of 14 segments. The delivery of these castings, which does not commence until after the preliminary work of the terminals has been completed, will extend over a period of two years or at the rate of approximately 133 segments per day. However the molding machine units furnished by the Osborn Co. will have a combined capacity considerably in excess of 200 segments daily.

Obituary

Edward M. Barr, Chicago manager for the Chisholm-Moore Mfg. Co., Cleveland, died suddenly in his office, March 15. Mr. Barr, who was born and resided until about 1902 in Milwaukee, was associated with the Chisholm-Moore firm for the past 11 years. He is survived by his wife and one son.

Samuel McClure, aged 83, general manager of the Steward Furnace Co., and former state senator, died March 25 at his home, 585 East State street, Sharon, Pa., after several weeks' illness. He was one of the veteran leaders in the founding, management and development of industrial and financial institutions of the Shenango Valley. Mr. McClure became associated in 1886 with F. H. Buhl and Daniel Egan, since deceased, in organizing the Sharon Steel Castings Co. of which he was elected vice president. In 1902 the plant was acquired by the American Steel Castings Co., and became a constituent company of the American Steel Foundries. Mr. McClure served for many years as president of the Sharon Savings and Trust Co., recently absorbed by the

McDowell National Bank. He also was president of the Sharon Railways Co. and was identified with other concerns, including the Shenango Machine Co., the Union Limestone Co., and the Sharon Connecting Railroad. Mr. McClure was president of the board of trustees of the F. H. Buhl Farm, president of the Union Limestone Co., Youngstown, and president of the Shenango Machine Co.

Established in New Plant

J. W. Paxson Co. recently has occupied its new plant at Nicetown Lane and D. street, Philadelphia. This plant, which occupies an entire block, was constructed under direction of A. G. Warren, chief engineer for the company. It includes pattern, machine, forge, smith, steel and boiler plate shops. Trolley directions for reaching the plant, which is open to inspection, advise the visitors to take a No. 28 trolley north on Third street to Tioga, walk two blocks north to Nicetown Lane, then east three blocks over the Pennsylvania railway bridge. An alternative route suggests any trolley north, a transfer east on Erie avenue to Second street, when the plant may be reached by walking four blocks east on Nicetown Lane.

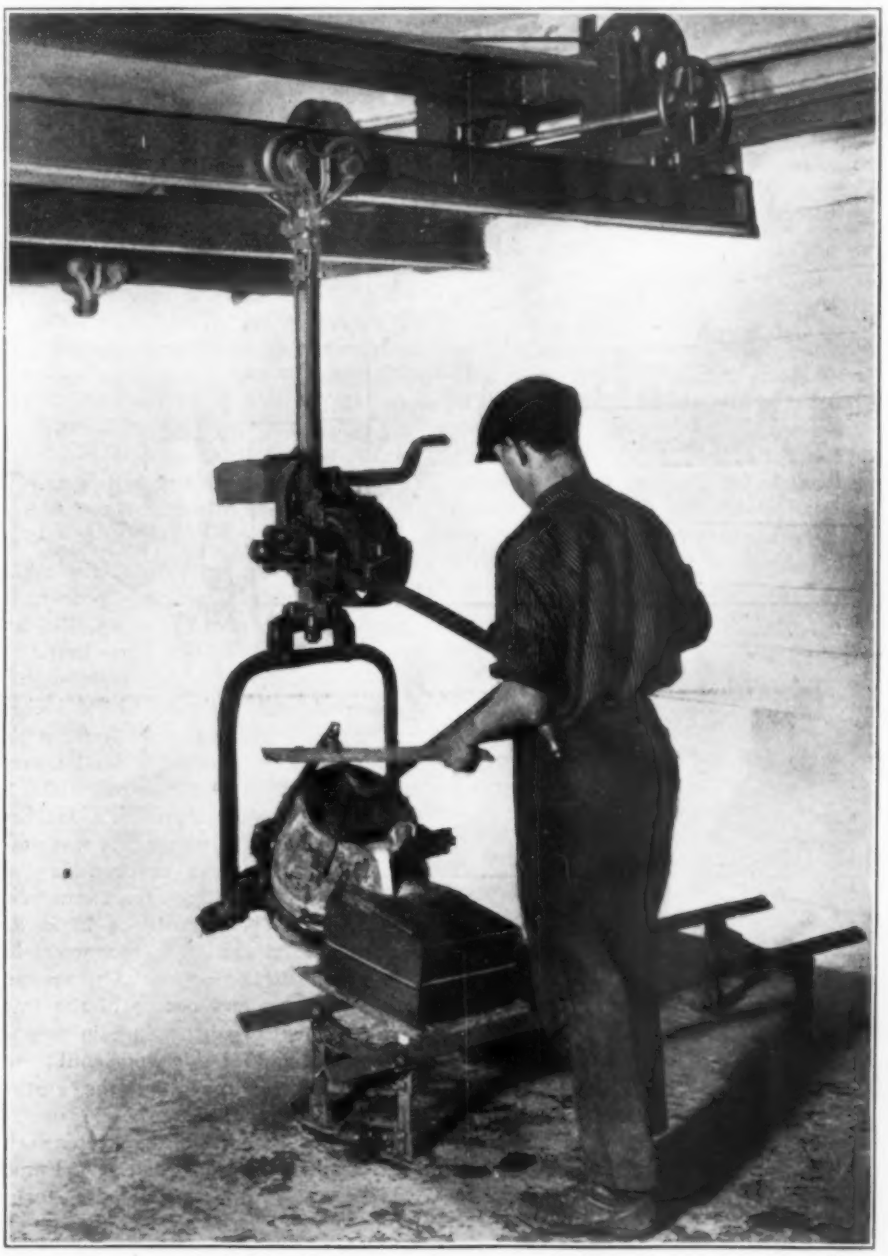
Pouring Device Makes for Casting Economy

One man can both pour and skim a crucible supported in the device shown in the accompanying illustration, recently placed on the market by the Modern Pouring Device Co., Port Washington, Wis. The machine is suspended from a trolley operating on a monorail or underhung crane and consists of a cast steel frame supported by two flat bars with a swivel arrangement at the upper end which acts as a guide for a rack raised by a ratchet and gear movement in the frame. The rack can be raised 7½ inches at one stroke of the lifting lever. The machine can be lowered to any desired point by disengaging the pawl in the hoisting lever and thus relieving the pressure on the brake band.

A crucible cover provided with two forked hooks that fit snugly over the crucible, is attached to the bent post at the back of the shank. A pipe lever projecting from the top of the cover may be employed in pouring from the front; or it may be attached to the end of the shank and employed to pour the crucible from one side. The manufacturer claims that by using a bent post on the back of the shank and forked hooks on the cover, bent on an angle not parallel to the center line of the crucible, it is possible to turn the crucible over completely without any danger of dropping it out of the shank. It also is claimed that the device is not limited in its application to crucible pouring, but will handle ladles up to 600 pounds capacity in foundries equipped with electric melting furnaces. A patent has been applied for on the machine.

Wire Brush Operates at 4000 Revolutions

The Ingersoll-Rand Co. New York recently has brought out a high speed revolving wire brush which has a maximum speed of 4200 revolutions per minute. It is stated this machine effectively cleans paint, rust, dirt and scale from cars, tanks, structural steel forms and iron and steel castings where the area to be cleaned is large and where speed is a desirable element. Not only does the brush do a first class cleaning job, but it is claimed effects a considerable saving of time and labor. On a six weeks test the machine cleaned steel gondolas each averaging 540 square feet of surface in 3½ hours. All-steel box cars each presenting on average of 1400 square feet of surface were cleaned in 7½ hours. The brush not only removed the rust but also the old paint. When repainted, the old cars practically looked as if new sheets had been employed. The air motor is of the 3-cylinder type used in a portable grinder made by the company and which has been thoroughly tested out in the severe service to which pneumatic grinders are subjected. The machine is simple in construction, is well balanced and operates without vibration. Lightness has



A LOCK ON THE SHANK PREVENTS THE CRUCIBLE FROM TIPPING WHEN NOT IN POURING POSITION

been attained by using an aluminum casing reinforced with cast-in steel bushings. The weight of the complete machine is 14 pounds. The average free speed at 90 pounds of air pressure is 4200 revolutions per minute. The overall length is 17½ inches and the diameter of the wire brush, 6 inches.

Purchase Lorain Foundry

The plant and equipment of the Aetna Steel Casting Co., Lorain, O., has been taken over by the newly incorporated Lorain Steel Foundry Co., capitalized at $250,000. This company is engaged in making plant improvements and will produce steel castings for steel works, rolling mills, railroads, automotive manufacturers and machinery builders. W. W. Davidson is president; W. D. Jones, vice president and secretary; and C. M. Hartzell is treasurer and sales manager.

A Correction

Proper credit for the article "Structure of White-Heat Malleable", appearing on page 286 of the April 1 issue of THE FOUNDRY was inadvertently omitted. This article originally appeared in the German publication *Stahl und Eisen*.

Operates on High or Low Pressure Steam

Designed for heating and ventilating industrial plants the thermo unit shown in the accompanying illustration recently has been developed by the Bayley Mfg. Co., Milwaukee. To a certain extent it is portable and self contained requiring only a change in pipe fittings to permit its removal to any part of the building. A series of steam coils is mounted in a suitable manner on a base carrying a motor-driven fan which forces air through the heated coils and a distributing device above the coils directs the heated air in any desired direction. It is enclosed in sheet steel and is fireproof with the additional advantage that its erection does not involve the necessity of cutting holes in the fire walls. High or low pressure steam may be used. Condensation is removed rapidly, thus keeping the entire radiating surface active at all times. Air may be taken from the floor of the room or from a duct leading to the outside. The coils are arranged in a manner which holds the air in contact for a maximum time before it is discharged into the room. Each coil leads from a header through which the steam enters and a valve on each coil furnishes a ready means for regulating the heat by cutting out as many coils as may be necessary. Exhausting cold air from the floor causes warm air from above to take its place. The fan is protected from abrasive particles by a dust proof casing. If necessary it may be mounted on a bracket out of the way. Outlets for distributing the heated air are provided through 2-way, 4-way or universal connections.

HEAT IS REGULATED BY INDIVIDUAL VALVES ON EACH COIL

Welding Process Saves 13-Ton Tar Kettle

An interesting example of the application of modern welding process is shown in the accompanying illustration. The 13-ton cast-iron kettle, 8 feet in diameter, 8½ feet high, with a flange and wall thickness of 2¾ inches, was cracked while in transit from the foundry to the plant of a well known manufacturer of roofing materials in Chicago. It was taken to a welding shop for repairs where it was discovered that it was cracked in two places, one extending from the rim downward for a distance of 18 inches and the other similar in character, for a distance of 26 inches. On account of the position and nature of the fractures the ordinary procedure in preparing a casting for welding could not be followed. Preheating the casting presented an unusual problem on account of the necessity of keeping the kettle in an upright position. Empty carbide cans to form a base for a temporary furnace were built up to a point just below the zone to be preheated. A firebrick furnace was erected on a light covering of thin steel sheets. Had it been feasible to employ ordinary preheating methods it is estimated that a saving of approximately 40 per cent might have been effected in time consumed on the job. The smaller crack was welded in 8 hours and the larger in 11½ hours by a crew of three men. The net saving to the roofing company was $1200 and the entire job required but three days as against a much longer time if the kettle had to be recast in the foundry.

THE KETTLE WAS REPAIRED WHILE IN AN UPRIGHT POSITION

Davis-Bournonville Co. and the Air Reduction Sales Co. recently have been amalgamated with offices at 342 Madison Ave., New York. The combination of these two interests brings together facilities for manufacturing and selling welding and cutting equipment, oxygen, acetylene, generators, carbide, nitrogen, argon and other sundries. The consolidated organization will be known as the Air Reduction Sales Co.

J. Ross Bates, 136 Liberty street, New York, and 128 School street, Watertown, Mass., has been appointed sales representative for Orton & Steinbrenner Co., Chicago, manufacturer of locomotive cranes and material handling equipment.

H. Simms, Simms Foundry Co., Racine, Wis., recently has taken over the Racine Furnace & Foundry Co. of that city. Plans are under way to organize both plants under the Simms Foundry Corp.

The Pelton Steel Co., Milwaukee, recently has been purchased by the Stowel Mfg. Co., South Milwaukee, and will be operated as a part of the latter firm's Milwaukee malleable plant. The Pelton name will be retained for the steel branch of the establishment.

Brisk Equipment Inquiry Continues

Eastern Demand, Dominated by Tunnel Segment Letting, Shows General Improvement —West Swings Into Line with an Increasing Inquiry Led by Interest in Small Machinery Units

FOLLOWING closely on the improvement noted during the past month, inquiry for all classes of foundry equipment is growing both in volume and in business bringing quality. The eastern market is slightly more active, due to a few large contracts for castings recently placed, but interest as evidenced by active inquiries is extending throughout the country. Automobile foundries again are buying machinery. One large Detroit interest recently ordered 12 squeezer type molding machines from the Berkshire Mfg. Co., Cleveland. Sales of molding machines in the Cleveland district during the past two weeks mark the high mark for almost a year. The Wisconsin Castings Co., Sheboygan, Wis. has been incorporated to manufacture gray iron castings, gas engines and implements in the plant of the Globe Metal Products Co., which recently was taken over.

Western Demand Catches Step

IN LINE with the increased demand for castings, foundries are more actively in the market for equipment and supplies and sellers find their inquiry much increased and bookings correspondingly greater. In molding machines, the preponderance of orders from eastern territory has been balanced by greater demand from the West and at present a number of live inquiries for single machines or small equipments are before manufacturers. Nothing approaching the recent purchase by the Ford Motor Co. has come out since that time. The Whiting Corp., Harvey, Ill., has booked three electric traveling cranes of 10 tons, five tons and two tons capacity, and a 66-inch cupola for the Coshocton Iron Works, Coshocton, O. Richardson & Boynton, Dover, N. J., have bought a 72-inch cupola from the same builder. Other recent sales by this interest include a 100-ton locomotive hoist for shipment to China and a two cubic yard bucket crane with 46-foot span for the Calumet station of the Commonwealth Edison Co., at Chicago. Sand mixing machinery is in demand. The National Engineering Co. is shipping four mixers, one each to a malleable foundry in Milwaukee, to a steel foundry in British Columbia, and a steel foundry near Winnipeg while another goes to a brass foundry in Oregon. One indication of the increased activity of foundries is a heavy demand for ladles, both the hand and geared varieties in all sizes.

Inquiry Sets Pace in Pittsburgh

BASED on orders, foundry equipment sellers in the Pittsburgh territory describe the market as fair, although from an inquiry standpoint it is exceedingly active and prospects are bright. While a few weeks ago the inquiries came only from a limited area, they now are coming from practically every consuming center, some being received here for foundry equipment and supplies from as far south as Texas. In fact, one recent inquiry for molding machines comes from Mexico. Several projects, sidetracked a few months ago, now are being revived and the equipment inquiries again are active. Included are a number of molding machines. Latterly the sale of molding machines has dropped off, according to the Herman-Pneumatic Machine Co., although it recently received an order for two small units from a Milwaukee foundry. Numerous inquiries for this type of equipment are current, a few of which involve several large outfits. One equipment deal involving $30,000 is the largest ever entertained by one representative supply house here and another steel company wants a complete sand blast outfit. An interesting inquiry before the trade involves several core ovens, core machines, mixers, wire straightener, etc., and the Penn Seaboard Steel Corp. is negotiating for two 108-inch cupolas. Several other core oven deals are up for attention including one from the Pittsburgh Valve, Foundry & Construction Co. The Mesta Machine Co. is having a number of doors on its core ovens replaced. The Wehrle Co., Newark, O., has purchased a new large sand blast outfit complete with tables, etc. Orders for crucibles are a matter of almost daily occurrence and flask orders latterly, likewise have been numerous. Many flask inquiries still are before the trade and give promise of early closing. While a few orders for electric furnaces have been placed lately, none have come from local foundries although several are interested and as soon as the industry picks up to an extent sufficient to warrant the outlay, electric as well as annealing furnaces are to be bought in a number of cases. The market for small foundry supplies is increasing, typifying an increased operating rate among foundries in this territory. A prospective purchaser of foundry equipment is the Danville Iron & Steel Corp., Danville, Pa., which is increasing its foundry capacity. Large roll foundries in this territory now are working on an average of 50 per cent of capacity whereas a short time ago the figure was around 25 per cent. Several crane inquiries are before the trade and a number of hoist purchases are contemplated.

Eastern Demand Strengthened

OUTSTANDING in the eastern equipment market is buying by the Bethlehem Steel Co., Bethlehem, Pa., and Davies & Thomas, Catasauqua, Pa., companies that recently have been awarded contract for producing the segments for the New York-New Jersey vehicular tunnel. The latter concern is closing on considerable sand-blast equipment; sand sifting and tempering apparatus; plain jolt machine and 10-foot jolt rollover machine, orders for the latter having been placed with the Osborn Mfg. Co., Cleveland; and three electric overhead cranes ranging from 7½ to 10 tons capacity and two jib cranes of 5 tons capacity. The company also contemplates purchasing an electric furnace in the near future. The Bethlehem Steel Co. requirements are expected to be equally as large, although possibly involving somewhat different items. Demand generally is improving, although aside from the buying above mentioned, orders continue small. The American Steel & Wire Co., is buying some equipment for its North Works foundry, Worcester, Mass., including a 2-ton tramrail system, placed with the Cleveland Crane & Engineering Co., and the American Car & Foundry Co., 165 Broadway, New York City, has closed on two 10-ton electric cranes, with 90-foot span, to the Shaw Electric Crane Co., Muskegon, Mich. These cranes are for the company's plant in Huntington, W. Va. An inquiry for a similar sized crane was issued for its Buffalo, N. Y. plant, but this was withdrawn later.

What the Foundries Are Doing

Activities of the Iron, Steel and Brass Shops

Erection of an office building is being planned by the Warren Foundry Co., Easton, Pa.

The capital stock of the Columbian Bronze Corp., Freeport, N. Y., recently was increased from $450,000 to $1,250,000.

The Lymburner Brass Works, 1025 Boyer street, Montreal, Que., is reported planning some improvements to its plant.

Work is progressing on additions and improvements to the plant of the U. S. Radiator Co., at Corry, Pa.

The Sharpsburg Foundry Co., Sharpsburg, Pa., is reported planning some improvements to its plant, including the installation of additional equipment.

The capacity of the plant of the Danville Iron & Steel Co., Danville, Pa., will be increased by the erection of a proposed plant addition.

The Advance Boiler Co., Poughkeepsie, N. Y., is reported planning the erection of a foundry building to be one story, 100 x 300 feet, and to cost about $100,000.

The Superior Foundries, Inc., Milwaukee, recently was incorporated with 500 shares of no par value common stock by C. Heinig, H. Schwind and C. Hoffman.

The Gilbert & Barker Mfg. Co., Springfield, Mass., manufacturer of pumps, etc., is reported planning the erection of a 1-story foundry building.

The plant of the Fischer-Sweeny Bronze Co., 1301-11 Grand street, Hoboken, N. J., manufacturer of bronze, aluminum and metal castings, recently was damaged by fire.

The Moncrief Furnace Co., Atlanta, Ga., is having plans prepared for the erection of a 1-story plant building to contain approximately 15,000 square feet of floor space.

Plans are being prepared by the Bowie Stove Co., East Rome, Ga., for the erection of a plant building, 100 x 400 feet, to replace one which recently was damaged by fire.

The James Graham Mfg. Co., Newark, Cal., manufacturer of stoves, etc., plans the erection of an addition to its plant, to be built at an estimated cost of $50,000.

Plans are reported being prepared by the Electric Steel & Metals, Ltd., Welland, Ont., calling for the erection of an addition to its plant to be 75 x 400 feet.

Plans are being prepared for the erection of additions and alterations to the shop and storehouse of the Stamford Foundry Co., Stamford, Conn.

The Cadillac Malleable Iron Co., Cadillac, Mich., has started construction of a foundry building, 120 x 200 feet, and an annealing building, 90 x 224 feet.

Plans are reported being prepared by the Trenton Emblem Co., Trenton, N. J., for the erection of a foundry building to be one story, 36 x 77 feet.

Capitalized at $25,000, the Eagle Foundry Co., Muncie, Ind., recently was incorporated by Harley D. Hartley, Holly B. Harvey and Roy H. Hartley, to engage in a general foundry business.

The Logan Foundry & Machine Co. and the Buckeye Oil & Supply Co., both of Logan, O., have been consolidated. The plants will be overhauled and a new building erected. The companies manufacture oil well supplies.

The Ever-Ready Heater Co., Inglewood, Cal., recently organized, with a capital stock of $500,000, has acquired 5 acres on which it plans the erection of a modern factory building. John B. Reeves is president of the company.

A gray iron foundry and several additions to the machine shops and erecting floor will be built by the U. S. Tractor & Machinery Co., Menasha, Wis. The company is enlarging its line of tractor and tractor implements.

The Young Bros. Foundry Co., Charleston, W. Va., recently organized, has plans under way for the erection of a foundry building to be devoted to the manufacture of iron and steel castings. R. M. and Walter Young, Charleston, are officers of the company.

R. J. Schwab & Sons Co., 283 Clinton street, Milwaukee, iron founder and manufacturer of furnaces, boilers, etc., is reported planning the erection of two plant additions, 30 x 72 feet and 40 x 50 feet, to provide for larger production.

The Canadian Rampo Iron Works, Niagara Falls, Ont., manufacturer of railroad switches, etc., is making some additions to its plant. Considerable new equipment has been installed and it is now proposed to erect a new building at an estimated cost of $100,000.

Articles of incorporation have been filed by the Domestic Foundry Co., North Milwaukee, Wis. The capital stock of the company is $10,000 and the incorporators include J. Orth, John Toennessen and Martin Schottler, attorney, 105 Wells street, Milwaukee.

The Pelton Steel Co., Milwaukee, recently has been purchased by the Stowel Mfg. Co., South Milwaukee, Wis., and will be operated as a part of the latter firm's Milwaukee malleable plant. The Pelton name will be retained for the steel branch of the industry.

The Indiana Foundry Corp., Muncie, Ind., recently was incorporated with a capital stock of $50,000, to engage in a general foundry business. The company was incorporated by Harley D. Hartley, Holly B. Harvey and Frederick D. Rose.

The American Car & Foundry Co., 165 Broadway, New York, has awarded a contract for foundation and other work for a brick and steel addition to its plant at Huntington, W. Va., to the Langhorne Co., to cost about $500,000, including equipment. J. W. Ensign is district manager of the company.

The Electric Alloy Steel Co., Youngstown, O., is installing a complete warehouse for stock in Detroit and soon will announce its opening. The Detroit district offices of the company now at 1716 Ford building, will be moved to the new warehouse as soon as arrangements are completed.

The Electric Foundry & Equipment Co., Tacony and Bleigh streets, Philadelphia, is arranging for the installation of electric furnaces, cranes and other equipment at its new plant, now in the course of erection, to be used for the production of steel castings. William P. Cunningham is president of the company.

The Colonial Steel Co., Pittsburgh, has bought a lot at 2121 St. Clair avenue, Cleveland, and is having plans and specifications prepared for a brick warehouse. The warehouse will contain furnaces and equipment for heat treating steel, with a view to assisting customers in solving problems of this nature and for investigating methods of treatment.

Plumbing specialties are being manufactured by the Hartwell Machine Co., Waltham, Mass., which recently moved into its new plant. The company, in addition to manufacturing plumbing specialties, which include iron and brass traps, steel and brass goods, etc., also does a jobbing business in iron, steel and brass goods. Guy R. Hartwell, president of the company, formerly was a member of the Steel Specialties Co., then of Waltham, but now of Wakefield, Mass.

Manufacturing and selling of gas stoves and ranges, together with a small line of coal stoves, is the purpose of the incorporation of the L. A. Althoff Mfg. Co., Chicago. The company recently completed the erection of a new plant comprising a building with approximately 25,000 square feet of floor space, two stories, and equipped with modern machinery and appliances. The company has a capitalization of $125,000. Officers are: President and treasurer, L. A. Althoff; vice president, M. F. Althoff, and secretary, F. J. Pasbach.

The Wisconsin Castings Co., Sheboygan, Wis., is the name of a new corporation which has been organized with $125,000 capital stock to operate the former plant of the Globe Metal Products Co., a foundry and machine shop concern recently acquired at trustee's sale by Harry W. Bolens, president of the Gilson Mfg. Corp., Port Washington, Wis., manufacturing gray iron castings, gas engines, farm tools and implements, tractors, etc. Mr. Bolens is the principal incorporator of the new company which is now rehabilitating the industry and plans to resume operations at once. Mr. Bolens paid $65,900 for the Globe plant.

Reorganization of the Atlas Die Casting Co., Worcester, Mass., has been effected according to an announcement by J. Herbert Johnson, formerly assistant sales manager of the grinding machine division of the Norton Co., who is treasurer and general manager of the Atlas organization. Edward G. Norman is president, and Harry Smith, Nathan Lester and Malcom A. Blanch are directors of the company. Mr. Lester, who is engineer for the company, formerly was with the Doehler Die Casting Co. and the Acme Die Casting Co., both of Brooklyn, N. Y.

New Trade Publications

PNEUMATIC TOOLS—The Independent Tool Co., Chicago, has published a large folder in which pneumatic and electric tools are described and illustrated. These include drills, grinders, hammers, hoists, riveting hammers, etc. Specifications are given.

SAWS—The Oliver Machinery Co., Grand Rapids, Mich., has published a 16-page illustrated booklet in which circular sawing machines are described and illustrated. The booklet contains some information and data which should be of particular interest to men in charge of woodworking machinery.

FERROALLOYS—The Electro Metallurgical Co., Niagara Falls, N. Y., has published a large 28-page booklet in which ferroalloys and metals are described. Brief descriptions of the most important metals and their uses in the fields of ferrous and nonferrous metallurgy are given, together with some historical data which are of interest, especially to those who have studied the subject.